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PRODUCT DATA REPRESENTATION AND EXCHANGE

Part: 215 Title: Application Protocol : Ship Arrangements

Purpose of this document as it relates to target document is:
__X__ Primary Content
_____ Issue Discussion
_____ Alternate Proposal
_____ Partial Content

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ABSTRACT:

This part of ISO 10303 defines an Application Protocol for the product data pertaining to the design of a ship's internal, spatial subdivision.

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Units of Functionality
ARM EXPRESS-G
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Comments to Reader

This document contains the Scope, Units of Functionality, Application Objects, ARM, Conformance Classes and Activity Model for the Ship Arrangements AP. This document is the updated version of AP215 for Committee Review at the October 1996 Toronto STEP Meetings, Qualification review, and Wide Industry Review.

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Foreword

The International Organisation for Standardisation (ISO) is a world-wide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organisations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardisation.

Draft International Standards adopted by technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 10303-215 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data.*

ISO 10303 consists of the following parts under the general title *Industrial automation systems and integration — Product data representation and exchange:*

- Part 1, Overview and fundamental principles;
- Part 11, Description method: EXPRESS language reference manual;
- Part 12, Description method: EXPRESS-I language reference manual;
- Part 13, Description method: Architecture and methodology reference manual;
- Part 21, Implementation method: Clear text encoding of the exchange structure;
- Part 22, Implementation method: Standard data access interface specification;
- Part 23, Implementation method: C++ language binding to the standard data access interface;
- Part 24, Implementation method: C language binding to the standard data access interface;
- Part 26, Implementation method: Interface definition language binding to the standard data access interface;
- Part 31, Conformance testing methodology and framework: General concepts;
- Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;
- Part 33, Conformance testing methodology and framework: Structure and use of abstract test suites;
- Part 34, Conformance testing methodology and framework: Abstract test methods;
- Part 35, Conformance testing methodology and framework: Abstract test methods for SDAI implementations;
- Part 41, Integrated generic resource: Fundamentals of product description and support;
- Part 42, Integrated generic resource: Geometric and topological representation;
- Part 43, Integrated generic resource: Representation structures;
- Part 44, Integrated generic resource: Product structure configuration;
- Part 45, Integrated generic resource: Materials;
- Part 46, Integrated generic resource: Visual presentation;
- Part 47, Integrated generic resource: Shape variation tolerances;
- Part 49, Integrated generic resource: Process structure and properties;
- Part 101, Integrated application resource: Draughting;
- Part 102, Integrated application resource: Ship structures;
- Part 104, Integrated application resource: Finite element analysis;
- Part 105, Integrated application resource: Kinematics;
- Part 106, Integrated application resource: Building construction core model;
- Part 201, Application protocol: Explicit draughting;
- Part 202, Application protocol: Associative draughting;
- Part 203, Application protocol: Configuration controlled design;
- Part 204, Application protocol: Mechanical design using boundary representation;
- Part 205, Application protocol: Mechanical design using surface representation;
- Part 207, Application protocol: Sheet metal die planning and design;
- Part 208, Application protocol: Life cycle management - Change process;

— Part 209, Application protocol: Composite and metallic structural analysis and related design;
— Part 210, Application protocol: Design of layered electronic products;
— Part 211, Application protocol: Electronics test diagnostics and remanufacture;
— Part 212, Application protocol: Electrotechnical design and installation
— Part 213, Application protocol: Numerical control process plans for machined parts;
— Part 214, Application protocol: Core data for automotive design processes;
— Part 215, Application protocol: Ship arrangement;
— Part 216, Application protocol: Ship moulded forms;
— Part 217, Application protocol: Ship piping;
— Part 218, Application protocol: Ship structures;
— Part 220, Application protocol: Process planning, manufacture, and assembly of layered electronic products;
— Part 221, Application protocol: Functional data and their schematic representation for process plant;
— Part 222, Application protocol: Exchange of product data for composite structures;
— Part 223, Application protocol: Exchange of design and manufacturing product information for cast parts;
— Part 224, Application protocol: Mechanical product definition for process plans using mechanical feature;
— Part 225, Application protocol: Building elements using explicit shape representation;
— Part 226, Application protocol: Ship mechanical systems;
— Part 227, Application protocol: Plant spatial configuration;
— Part 228, Application protocol: Building services: Heating, ventilation, and air conditioning;
— Part 229, Application protocol: Exchange of design and manufacturing product information for forged parts;
— Part 230, Application protocol: Building structural frame: Steelwork;
— Part 231, Application protocol: Process engineering data: Process design and process specification of major equipment;
— Part 301, Abstract test suite: Explicit draughting;
— Part 302, Abstract test suite: Associative draughting;
— Part 303, Abstract test suite: Configuration controlled design;
— Part 304, Abstract test suite: Mechanical design using boundary representation;
— Part 305, Abstract test suite: Mechanical design using surface representation;
— Part 307, Abstract test suite: Sheet metal die planning and design;
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- Part 326, Abstract test suite: Ship mechanical systems;
- Part 327, Abstract test suite: Plant spatial configuration;
- Part 328, Abstract test suite: Building services: Heating, ventilation, and air conditioning;
- Part 329, Abstract test suite: Exchange of design and manufacturing product information for forged parts;
- Part 330, Abstract test suite: Building structural frame: Steelwork;
- Part 331, Abstract test suite: Process engineering data: Process design and process specification of major equipment;
- Part 501, Application interpreted construct: Edge-based wireframe;
- Part 502, Application interpreted construct: Shell-based wireframe;
- Part 503, Application interpreted construct: Geometrically bounded 2D wireframe;
- Part 504, Application interpreted construct: Draughting annotation;
- Part 505, Application interpreted construct: Drawing structure and administration;
- Part 506, Application interpreted construct: Draughting elements;
- Part 507, Application interpreted construct: Geometrically bounded surface;
- Part 508, Application interpreted construct: Non-manifold surface;
- Part 509, Application interpreted construct: Manifold surface;
- Part 510, Application interpreted construct: Geometrically bounded wireframe;
- Part 511, Application interpreted construct: Topologically bounded surface;
- Part 512, Application interpreted construct: Faceted boundary representation;
- Part 513, Application interpreted construct: Elementary boundary representation;
- Part 514, Application interpreted construct: Advanced boundary representation;
- Part 515, Application interpreted construct: Constructive solid geometry;
- Part 516, Application interpreted construct: Mechanical design context;
- Part 517, Application interpreted construct: Mechanical design geometric presentation;
- Part 518, Application interpreted construct: Mechanical design shaded representation.

The structure of this International Standard is described in ISO10303-1. The numbering of the parts of the International Standard reflects its structure:

- Parts 11 to 13 specify the description methods,
- Parts 21 to 26 specify the implementation methods,
- Parts 31 to 35 specify the conformance testing methodology and framework,
- Parts 41 to 49 specify the integrated generic resources,
- Parts 101 to 106 specify the integrated application resources,
- Parts 201 to 231 specify the application protocols,
- Parts 301 to 331 specify the abstract test suites, and
- Parts 501 to 518 specify the application interpreted constructs.

Should further parts be published, they will follow the same numbering pattern.

Annexes A, B, C, D, and E form an integral part of this part of ISO 10303. Annexes, F, G, H, J, and K are for information only.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product, independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organised as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application protocol series.

This part of ISO 10303 specifies an application protocol for the exchange of product data representing a ship's internal subdivision information between different organizations with a need for that data. Such organizations include ship owners, design agents, and fabricators.

This part of ISO 10303 is one of a series of shipping industry application protocols, that together aim to provide an integrated computer interpretable product model for ships.

The series of shipping industry application protocols assumes that the ship product model can be divided into separate ship systems that each cover a key element of the ship for its whole life cycle. These key elements are: ship moulded forms, ship arrangements, ship distribution systems, ship structures, ship mechanical systems, ship outfit and furnishings, and ship mission systems. Each separate system is described by one or more different application protocols. The full series of shipping application protocols is shown in Figure 1. Those aspects of the ship product model that are common to each shipping application protocol are described consistently and identically in each application protocol.

This AP has been developed to support the shipbuilding activities and computer applications associated with the Functional Design, Detail Design, and Production Engineering life cycle phases for commercial or military ships. The types of design activities and computer applications supported include structural analysis, naval architectural analyses (e.g., Longitudinal Strength, Intact and Damaged Stability, Floodable Length, Ship Motions, and Resistance and Propulsion), Weight Analysis, system penetration analysis, interference analysis, shock analysis, and material requirements definition. Figure 2 illustrates the major types of data supported by this AP. Annex L provides additional information pertaining to the industrial use of this AP.

This application protocol defines the context, scope, and information requirements for the exchange of ship arrangement definitions, geometric representations, and related properties and specifies the integrated resources necessary to satisfy these requirements.

Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarises the functionality and data covered by the AP. Clause 3 lists the words defined in this part of ISO 10303 and gives pointers towards defined elsewhere. An application activity model, that is the basis for the definition of the scope, is provided by annex F. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model, is given in annex G.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes which are not imported into the AIM. The expanded listing given in annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex H. Additional requirements for specific implementation methods are given in annex D.

Industrial automation systems and integration — Product data representation and exchange — Part 215: Application Protocol : Ship Arrangements

1. Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for the exchange of three-dimensional product definition data and its configuration status information for Naval and commercial ship arrangements. Configuration in this context pertains to data specific to revision tracking and change history of selected ship spatial entities within the Product model. The term exchange is used to narrow the scope to only those data which are transferred between enterprise systems. This is to distinguish it from a data model supporting distributed, multi-user database applications.

NOTE - The application activity model in annex F provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this part of ISO 10303.

The following are within the scope of this part of ISO 10303:

- data describing the general subdivision of a ship into spatially bounded regions;
- data identifying physical boundaries partitioning the ship into compartments suitable for the stowage of cargo, operation of machinery, and occupancy by crew and passengers;
- data identifying logical boundaries subdividing the ship into zones for the purpose of controlling access, designating design authority, or applying specific design requirements;

  EXAMPLE 1 - design zone, fire zone, subsafe zone, and collective-protective systems zone are types of zones.
- data required for the determination of space adjacency;
- data required for recording the volumetric capacities of cargo compartments at various combinations of sounding, vessel heel, and vessel trim;
- data required for calculation of the magnitude and location of loads acting upon a ship's structural systems due to the weight of cargos contained in the cargo compartments;
- data identifying the accessibility and transit time between adjacent spaces;
- data required for the definition of spatial boundaries based on moulded form regions, geometric surfaces, or bounding boxes;
- data identifying spaces related by common functional purpose;
- data identifying spaces related by position;

  EXAMPLE 2 - port and starboard wing tank pairs are spaces related by position.
- data identifying spaces enclosing other spaces;
- data identifying lineal measurement constraints on dimensional aspects of spaces;
- data identifying the product structuring of engineering parts and structural parts contained within a space;
- data required for the definition of design requirements placed on a space by systems within the ship.

The following are outside the scope of this part of ISO 10303:

2. Normative references

The following standards contain provision which, through reference in this text, constitute provisions of this part of ISO 10303. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of the IEC and ISO maintain registers of currently valid International Standards.

ISO 31:1994, *Quantities and Units.*
ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units.*
ISO 8824-1:1994. Information Technology — Open Systems Interconnection — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of Basic notation.
ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles.*
ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual.*
ISO 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure.*
ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts.*
ISO 10303-42:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resources: Geometric and topological representation.*
ISO 10303-43:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resources: Representation structures.*
ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration.*
ISO 10303-46:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation.*
ISO 10303-508: — [1)] *Industrial automation systems and integration — Product data representation and exchange — Part 508: Application interpreted constructs: : Geometrically bounded wireframe*
ISO 10303-510: — [1)] *Industrial automation systems and integration — Product data representation and exchange — Part 510: Application interpreted constructs: Non-manifold surface representation*

3. Definitions and abbreviations

3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1:

- application;
- application activity model (AAM);
- application context;
- application interpreted model (AIM);
- application object;
- application protocol (AP);
- application reference model (ARM);
- computer aided design (CAD);
- computer aided manufacture (CAM);
- conformance class;
- conformance requirement;
- data;
- data exchange;
- implementation method;
- information;
- integrated resource;
- interpretation;
- PICS proforma;
- product;
- product data;
- unit of functionality (UoF).

3.2 Terms defined in ISO 10303-31

This part of ISO 10303 makes use of the following terms defined in ISO 10303-31:

— conformance testing;
— postprocessor.
— preprocessor;

3.3 Terms defined in ISO 10303-42

This part of ISO 10303 makes use of the following terms defined in ISO 10303-42:

— boundary;
— closed curve;
— connected;
— open curve;
— orientable;

3.4 Other definitions

For the purposes of this part of ISO 10303, the following definitions apply:

3.4.1 after perpendicular: a vertical line located at the intersection of the summer load (design) waterline and the after side of the rudder post or sternpost, or the centerline of the rudder stock if there is no rudder post or sternpost.

3.4.2 amidships: a point located exactly mid-way between the Forward and After Perpendiculars. It is primarily used as a reference to locate or measure items longitudinally on a ship.

3.4.3 bulkhead: the vertical partition walls which subdivide the interior of a ship into compartments or rooms. The various types of bulkheads are distinguished by their location, use, kind of material, or method of fabrication, such as forepeak, longitudianl, transverse, watertight, wire mesh, pilaster, etc. Bulkheads which contribute to the strength of a vessel are called strength bulkheads, those which are essential to the watertight subdivision are watertight or oiltight bulkheads, and gastight bulkheads serve to prevent the passage of gases or fumes.

3.4.4 3.2.3 centroid: the center of an item, area or volume measured with respect to some defined location. Within shipbulding, it is expressed as a vertical component measured above the baseline, a transverse component measured from the centerline, and a longitudinal component measured from either Amidships, or the Forward Perpendicular.

3.4.5 collective-protective system zone: a region of a ship completely isolated from the outside environment for the purposes of protecting the crew from breathing toxic or germ infected air. This is accomplished by maintaining a positive air pressure with respect to non-protected regions.

3.4.6 compartment:

3.4.7 deck: a platform in a ship corresponding to a floor in a building. It is the plating, planking, or covering of any tier of beams either in the hull or superstructure of a ship.

3.4.8 design zone:

3.4.9 engineering part: a supertype of part occurrences (i.e. Device Occurrence, Distribution Part Occurrence, or Discrete Part Occurrence) that are configuration managed. These part occurrences are separate and distinct from Structural Part Occurrences. For a more complete definition, refer to reference 4.

3.4.10 fire zone: an abstract boundary defining a region of the ship requiring special consideration with regard to its ability to contain and/or withstand a fire. There may be several fire zones on a ship, each with different characteristics.

3.4.11 forward perpendicular: a vertical line at the intersection of the foreside of the stem profile and the summer load (i.e. design) waterline. It is commonly used as a reference point for measuring or locating items longitudinally on a ship.

3.4.12 3.2.11 frame: a term used to designate one of the transverse members that make

up the riblike part of the skeleton of a ship. The frames act as stiffeners, holding the outside plating in shape and maintaining the transverse form of the ship.

3.4.13 hullform: the collection of geometry that defines the shape of the watertight envelope of the ship. This typically includes the underwater shell, the uppermost watertight deck or decks, and the internal watertight transverse and longitudinal bulkheads.

3.4.14 HVAC part: a subtype of Distribution Part Occurrence that refers to elements in an HVAC system. It is a supertype for both HVAC components and HVAC duct occurrences.

3.4.15 moulded form: a classification of geometry representing a reference location, curve, or surface. Structural members are located relative to the moulded form geometry according to standard practices (e.g., the inside surface of flush shell plating is on the moulded surface).

3.4.16 outfit & furnishing part: a supertype of parts that represent non-structural and non-distributed system parts. In the context of the NIDDESC AP's, O&F parts include such things as manholes, hatches, joiner bulkheads, ladders, gratings, and windows.

3.4.17 sounding:

3.4.18 station: the intersection of a transverse plane with the molded hullform. Typically, the shape of the ship is defined by 20 stations equally spaced along the length of the vessel. These stations define the cross-sectional shape and are used along with the waterlines and buttocks to represent the 3-dimensional wireframe shape of the ship.

3.4.19 structural opening: an opening in a structural part to allow penetration of another structural part, penetration of a distribution system part, passage of air and/or liquid, access through a structural part, lightening of a structural part to improve efficiency, or clearance between joined structural parts.

3.4.20 structural part:

3.4.21 subdivision: the internal, spatial partitioning of a ship into volumetric-based zones or compartments for the purposes of improving survivability in the event of damage or to segregate areas of the vessel for different purposes, such as the carriage of liquids, cargo, passengers, etc**.**

3.4.22 subsafe zone: an abstract boundary defining a region of a ship with special design and/or production requirements with regard to criteria for use on a submersible vessel.

3.4.23 superstructure: a decked-over structure above the upper deck, the outboard sides of which are formed by the shell plating as distinguished from a deckhouse that does not extend outboard to the ship's sides.

3.4.24 vessel heel:

3.4.25 vessel trim:

3.4.26 zone: an abstract boundary identifying a region of a ship with unique requirements or characteristics which must be specially treated in the design and/or manufacturing process. Typically, these zones carry such designations as Design Zone, Fire Zone, CPS Zone, Subsafe Zone, Ship Work Authorization Boundary Zone, etc.

3.5 Abbreviations

For the purposes of this Part of ISO 10303, the following abbreviations apply:

AAM Application Activity Model
AIM Application Interpreted Model
AP Application Protocol
ARM Application Reference Model

CAD Computer Aided Design
CAM Computer Aided Manufacture
IMO International Maritime Organisation
PICS Protocol Implementation Conformance Statement
SI Système International
SOLAS Safety of Life at Sea
UoF Units of Functionality

4. Information Requirements

This clause specifies the information required for the exchange of ship arrangement definitions, geometric representations and related properties.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using the terminology of the subject area of this application protocol.

NOTES

1 - A graphical representation of the information requirements is given in annex G.

2 - The information requirements correspond to those of the activities identified as being within the scope of this application protocol in annex F.

3 - The mapping table specified in 5.1 shows how the integrated resources and application interpreted constructs are used to meet the information requirements of this application protocol.

4.1 Units of Functionality

This subclause specifies the units of functionality for the ship arrangements application protocol. This part of ISO 10303 specifies the following units of functionality:

— **approvals**;
— arrangement_descriptions;
— arrangement_relationships;
— cargo_assignment;
— cargoes;
— **changes**;
— coatings;
— compartments;
— compartment_design_definitions;
— compartment_properties;
— **coordinate_axes**;
— **definitions**;
— **external_references**;
— **geometrically_bounded_wireframe_representations**;
— **hydrostatics_for_AP215**;
— **items**;
— loading_conditions;
— **moulded_forms**;
— **moulded_form_representations**;
— **non_manifold_surface_representations**;
— parts**;**
— **ships**;
— ship_curves; (need to add AOs)
— ship_general_characteristics; (need to add AOs)
— ship_surfaces; (need to add AOs)
— tonnage;
— **versions**;

— weight_data.

Figure 2 illustrates how the UoFs to be grouped under the following headings:

lifecycle definitions;

approvals;

moulded form items;

representations.

The group of UoFs labelled approvals describes the approval, versioning and change control of the definitions for moulded forms. This group of UoFs includes data such as who and when approved a definition and the effect of changing a definition.

The group of UoFs labelled lifecycle definitions describes the moulded form independent of its composition and its geometric representation. This group includes data such as the length between the forward and after perpendiculars, the identity of the ship and any relevant hydrostatic definitions.

The group of UoFs labelled moulded form items describes the basic composition of the moulded form. This group includes data such as what definitions are associated with a moulded form, how that moulded form relates to other moulded forms and how these are associated with a particular ship.

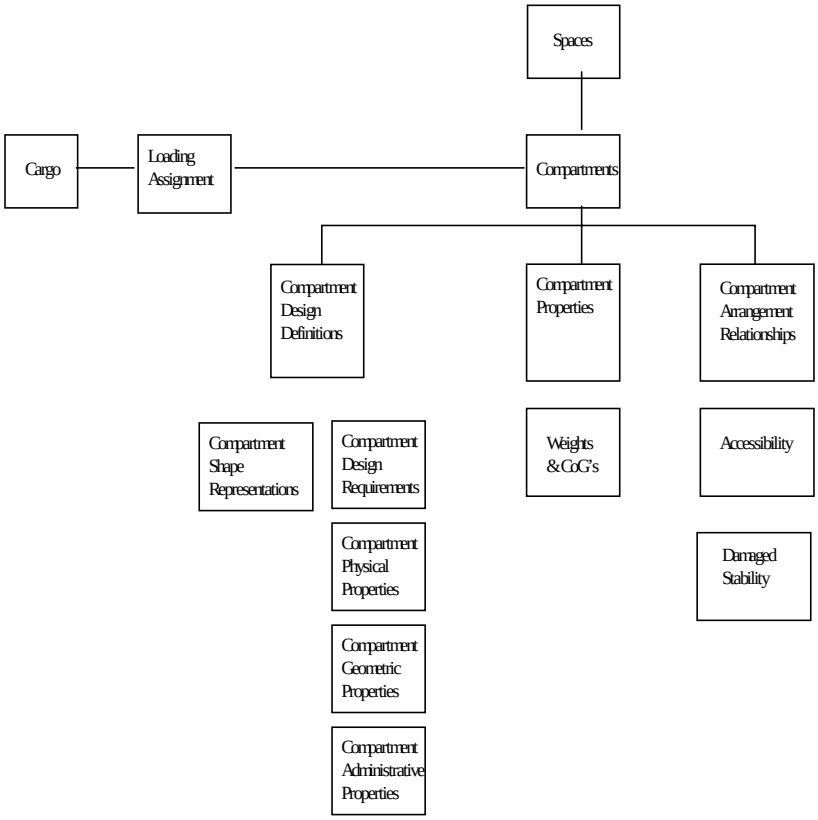

Figure 2- UoF groups

The group of UoFs labelled representations describes the geometry and combinations of geometry that can be used to represent the moulded form. This geometry includes points, curves and surfaces and individual UoFs describe each of the permissible types of geometry. The geometry may also have naval architecture terminology associated with it.
The units of functionality and a description of the functions that each UoF supports are given below. The application objects included in the UoFs are defined in 4.2.

4.1.1 approvals

This UoF specifies the information required to track the approval of compartment definitions. The approvals UoF describes when, who and what has been approved and to what level of approval. Also, it describes how approvals are related to each other. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the approvals UoF:

- Approval_event;
- Approval_history;
- Approval_relationship;
- Approval_relationship_event;
- Approval_structure;
- Event.

4.1.2 arrangement_descriptions

The arrangement_descriptions UoF
The following application objects are used by the arrangement_descriptions UoF:

- Arrangement_description;
- Arrangement_item_description.

4.1.3 arrangement_relationships

The arrangement_relationships UoF
The following application objects are used by the arrangement_relationships UoF:

- Adjacent_space_surface_area;
- Space_adjacency_relationship;
- Space_enclosing_relationship;
- Space_functional_relationship;
- Space_positional_relationship;
- Space_connection_relationship;
- Space_ relationship.

4.1.4 cargo_assignment

The cargo_assignment UoF
The following application objects are used by the cargo_assignment UoF:

- Absolute_cargo_position;
- Bay_cell_position;
- Bulk_cargo_assignment;
- Cargo_assignment;
- Cargo_position;
- Compartment_cargo_assignment;
- Deck_cargo_assignment;
- Lane_position;
- Liquid_cargo_assignment;
- Unit_cargo_assignment.

4.1.5 cargoes

The cargoes UoF
The following application objects are used by the cargoes UoF:

— Bulk_cargo;
— Cargo_footprint;
— Cargo_material_properties;
— Dangerous_goods_code;
— Dry_cargo;
— Gaseous_cargo;
— Liquid_cargo;
— Person_group;
— Ship_cargo;
— Unit_cargo.

4.1.6 changes

This UoF specifies the information required to track the effect of a change to a compartment definition. The changes UoF describes when and who changed what definition. Also, it describes the impact of the change in terms of whether or not other definitions are created, modified or deleted. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the changes UoF:

— Change;
— Change_impact;
— Change_plan;
— Change_realisation;
— Change_request;
— Change_state;
— Check;
— Definition_change_event;
— Definition_creation;
— Definition_deletion;
— Definition_modification;
— Envisaged_definition_creation.

4.1.7 coatings

The coatings UoF
The following application objects are used by the coatings UoF:

— Coating;
— Coating_certification;
— Corrosion_control_coating;
— Fire_safe_coating;
— Primer_coating.

4.1.8 compartments

The compartments UoF defines the core information requirements necessary to represent the spatial partitioning of the interior volume of the ship. It supports both the physical subdivision of the space into compartments, and the logical subdivision of the space into zones.
The following application objects are used by the compartments UoF:

— Compartment;
— Cargo_compartment;
— Cargo_compartment_functional_definition;
— Habitable_compartment;
— Habitable_compartment_functional_definition;
— Machinery_compartment;
— Machinery_compartment_functional_definition;

— Space;
— Space_relationship;
— Tank_compartment;
— Tank_compartment_functional_definition;
— Void_compartment;
— Void_compartment_functional_definition;
— Zone;
— Zone_function.

4.1.9 compartment_design_definitions

The compartment_design_definitions UoF
The following application objects are used by the compartment_design_definitions UoF:

— Cargo_bay_definition;
— Cargo_compartment_design_definition;
— Compartment_design_definition;
— Compartment_shape_representation;
— Compartment_shape_representation_2d;
— Compartment_shape_representation_3d;
— Design_requirement;
— Habitable_compartment_design_definition;
— Machinery_compartment_design_definition;
— Tank_compartment_design_definition;
— Void_compartment_design_definition;
— Zone_design_definition.

4.1.10 compartment_properties

The compartment_properties UoF
The following application objects are used by the compartment_properties UoF:

— Capacity_properties;
— Cargo_compartment_property_set;
— Coating_level;
— Compartment_areas;
— Compartment_naval_administrative_properties;
— Compartment_permeability;
— Compartment_property_set;
— Compartment_volume;
— Corrosion_protection;
— General_compartment_property_set;
— Habitable_compartment_property_set;
— Moments_of_inertia;
— Tank_compartment_property_set;
— Tank_geometric_parameters;
— Tank_piping_design_properties.

4.1.11 coordinate_axes

This UoF specifies the information required to define the ship’s coordinate system and to subdivide it into intervals so that they form the reference basis for points in the axis system. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the coordinate_axes UoF:

— Global_axis_placement;
— Local_co_ordinate_system;

— Longitudinal_position;
— Spacing_grid_definition;
— Spacing_position;
— Spacing_table.

4.1.12 definitions

This UoF specifies the information required to describe the overall points of interest for compartment definitions. The definitions UoFs specifies the units and representations associated with definitions and to what compartment they apply. Also, it describes how definitions are related to each other. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the definitions UoF:

— Definition;
— Definition_relationship;
— Design_definition;
— Functional_definition;
— General_characteristic_definiton;
— Manufacturing_definition;
— Technical_description.

4.1.13 external_references

The external_references UoF specifies the information required to reference documents or electronic files external to an ISO 10303-11 exchange file conforming to this part of ISO 10303.
The following application objects are used by external_references UoF:

— Document;
— Document_usage_constraint;
— Document_reference;
— Universal_resource_locator;
— External_reference;
— External_reference_inside_source.

4.1.14 geometrically_bounded_wireframe_representations

This UoF specifies the information required to represent the moulded forms bounding a compartment as a collection of 3D curves and points. Both simple geometry such as straight lines and complex geometry such as B-spline curves are described by this UoF. Additionally these may be associated with naval architecture terms. The curves may be inter-connected but such information is derived from the geometry and not stated explicitly by use of topology. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the geometrically_bounded_-wireframe_representations UoF:

— Geometrically_bounded_wireframe.

4.1.15 hydrostatics_for_AP215

This UoF specifies the results of calculations of the geometric properties of the hull associated with its displacement in still water.
The following application objects are used by the hydrostatics_for_AP215 UoF:

— Displacement;
— Floating_position.

4.1.16 items

This UoF specifies the information required to describe the generic product structure underlying the composition of a compartment. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the items UoF:

— Item;
— Item_relationship;
— Item_structure.

4.1.17 loading_conditions

The loading_conditions UoF defines the assignment of a cargo to a compartment within a ship.
The following application objects are used by the loading_conditions UoF:

- Deadweight;
- Loading_condition_definition;
- Loading_condition_design_definition;
- Loading_condition_operating_definition.

4.1.18 moulded_forms

This UoF specifies the information required to describe a moulded form, the composition of a moulded form and how this is associated with a particular ship.
The following application objects are used by the moulded_forms UoF:

- Moulded_form;
- Moulded_form_design_definition;
- Moulded_form_relationship.

4.1.19 moulded_form_representations

This UoF specifies the representation information required by a moulded form that is independent of the specific geometric constructs that are used in the representation. This UoF assigns global characteristics to individual representations such as their units or the nature of any symmetry. The units referenced by the moulded_form_representations UoF shall be SI units. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the moulded_form_representations UoF:

- Moulded_form_representation;
- Moulded_form_representation_relationship;
- Moulded_form_representation_symmetry.

4.1.20 non_manifold_surface_representations

This UoF specifies the information required to represent a moulded form that comprises a compartment boundary as a collection of 3D surfaces, curves and points. Both simple geometry such as planes and straight lines and complex geometry such as B-spline curves and surfaces are described by this UoF. Additionally these may be associated with naval architecture terms. If the curves and surfaces are inter-connected then such information is stated explicitly by the use of topology. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the non_manifold_surface_representations UoF:

- Non_manifold_surface_representation.

4.1.21 parts

This UoF specifies
The following application objects are used by the parts UoF:

- Part;
- Part_relationship.

4.1.22 ships

This UoF specifies the information required to describe the ship. All ship product data are defined independently of the ship and have a reference to it. The ships UoF describes the essential information to permit that reference. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the ships UoF:

- Ship.

4.1.23 ship_curves

This UoF specifies the naval architecture nomenclature and categorisation given to curves used in the representation of ship moulded forms. This UoF is common to all Shipbuilding related Application Protocols.
The following application objects are used by the ship_curves UoF:

- Curve;

— Ship_curve.

4.1.24 ship_general_characteristics

This UoF specifies the basic information that details the ship's dimensions and identification. This information is independent of any geometric context. This information includes scalar values for dimensions and identification labels for ship related companies. This UoF is common to all Shipbuilding related Application Protocols.

The following application objects are used by the ship_general_characteristics UoF:

Class_designation;
Class_notation;
Class_parameters;
Keel_parameters;
Moulded_form_characteristics;
Overall_dimensions;
Owner_designation;
Principal_characteristics;
Propeller_characteristics;
Regulations;
Ship_designation;
Shipyard_designation.

4.1.25 ship_surfaces

This UoF specifies the naval architecture nomenclature and categorisation given to surfaces used in the representation of ship moulded forms. This UoF is common to all Shipbuilding related Application Protocols.

The following application objects are used by the ship_surfaces UoF:

— Ship_surface;
— Surface.

4.1.26 tonnage

This UoF specifies

The following application objects are used by the tonnage UoF:

— Compartment_group;
— Compensated_gross_tonnage;
— Gross_tonnage;
— Net_tonnage;
— Tonnage_measurement;
— Tonnage_definition.

4.1.27 versions

This UoF specifies the information required to track versions of compartment definitions. The versions UoF describes what definition is subject to versioning and how different versions are related to each other to provide a version history. This UoF is common to all Shipbuilding related Application Protocols.

The following application objects are used by the versions UoF:

— Version_history;
— Version_relationship.

4.1.28 weight_data

This UoF specifies

The following application objects are used by the weight_data UoF:

— Moment_3d;
— Weight_and_centre_of_gravity.

4.2 Application objects

This subclause specifies the application objects for the ship arrangements application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes

specifying the data elements of the object. The application objects and their definitions are given below.

4.2.1 Absolute_cargo_position

An absolute_cargo_position is a type of Cargo_position. It is the position of a unit cargo in terms of a position in the ship global coordinate system.

The data associated with an Absolute_cargo_position are the following:

— orientation;

— position.

4.2.1.1 orientation

The orientation specifies the orientation of the unit cargo. It specifies the angle between the x-axis of the Unit_cargo's local coordinate system and the x-axis of the ship's global coordinate system, given that the z-axes of the two coordinate systems are parallel. The angle is positive if the rotation of the unit cargo x-axis is in an anti-clockwise direction with respect to the global x-axis.

4.2.1.2 position

The position specifies the position of the origin of the unit cargo's local coordinate system within the global coordinate system of the ship.

4.2.2 Adjacent_space_surface_area

The Adjacent_space_surface_area is the area of that portion of the boundary between adjacent spaces that is common to both spaces. This value can be used for heat loss anaylsis between the two Spaces.

EXAMPLE 1 - Two compartments are divided by a longitudinal bulkhead 8 ft high. One compartment is 10 ft wide and the other is 6 ft wide. The adjacent space surface area would be 48 square feet (8 ft * 6 ft).

The data associated with an Adjacent_space_surface_area are the following:

— surface_area.

The surface_area specifies the area measure of shared boundary between the adjacent Spaces.

4.2.3 Approval_event

An Approval_event triggers the change of an Approval_status.

The data associated with an Approval_event are the following:

— result.

The result specifies the Approval_status that the event leads to.

The value of the result shall be one of the following:

— noted;

— unapproved;

— approved;

— rejected.

NOTE - See 4.2.3.1 - 4.2.3.4 for the definition of each allowable value for result.

4.2.3.1 noted: the need for an approval decision for a version of the Definition has been identified.

4.2.3.2 unapproved: the approval status of a version of the Definition is in the process of being reviewed by the organization.

4.2.3.3 approved: a version of the Definition has been approved for use in a later lifecycle phase.

4.2.3.4 rejected: the version of the Definition has been rejected for use in a later lifecycle phase.

4.2.4 Approval_history

An Approval_history is a colloection of all Approval_events of a specific type defined for a Definition.

The data associated with an Approval_history are the following:

— approvals;

— status;

— subject.

4.2.4.1 approvals

The approvals specifies the sequence of Approval_events having occurred up to a point in time. Every Approval must have an associated Approval_status, thus the history must consist of at least one Approval_event. The list is assumed to be in chronological order.

4.2.4.2 status

The status specifies the current approval status.

4.2.4.3 subject

The subject specifies the Definition an approval is related to.
NOTE - A Definition may have zero, one or many associated Approvals. In case it has more then one associated Approval, all of them shall be different.

4.2.5 Approval_relationship_event

An Approval_relationship_event is a type of Event (see) that notes the change of an Approval_relationship_status.
The data associated with an Approval_relationship_event are the following:

— result.

The result specifies the Approval_relationship_status for the event.
The value of the result shall be one of the following:

— unapproved;
— approved;
— rejected.

NOTE - See 4.2.5.1 - 4.2.5.3 for the definition of each allowable value for result.

4.2.5.1 unapproved: the approval status of a version of the Definition is in the process of being reviewed by the organization.

4.2.5.2 approved: a version of the Definition has been approved in the context of another Definition.

4.2.5.3 rejected: a version of the Definition has been rejected in the context of another Definition.

4.2.6 Approval_relationship

An Approval_relationship is the hierarchical association of two Approval_histories, where the constrained_item is qualified according to the status.
The data associated with an Approval_relationship are the following:

— approval_context;
— approval_relationship_history;
— constrained_item;
— status.

4.2.6.1 approval_context

The approval_context specifies the Approval_history which provides the basis for comparison with the constrained_item.

4.2.6.2 approval_relationship_history

The approval_relationship_history specifies the most up to date chronological sequence of Approval_relationship_events that have occurred. There may be more than one approval_relationship_history for an Approval_relationship.

4.2.6.3 constrained_item

The constrained_item specifies the Approval_history which is constrained with respect to its possible approval through its approval_context.

4.2.6.4 status

The status specifies the current Approval_relationship_status associated with the Approval_relationship.

4.2.7 Approval_stucture

An Approval_structure is a hierarchy of Approval_relationships. The association between any two Approval_histories in this hierarchy means that one Approval_relationship is approved in the context of another Approval_relationship. An Approval_structure forms a directed acyclic graph.
The data associated with an Approval_stucture are the following:

— approval_item_relationships;

— approval_items.

4.2.7.1 approval_item_relationships

The approval_item_relationships specifies the Approval_relationships that constitute an Approval_structure. There may be more than one approval_item_relationships for an Approval_structure.

4.2.7.2 approval_items

The approval_items specifies the Approval_histories that consitiute the Approval_structure. There may be more than one approval_items for an Approval_structure.

4.2.8 Arrangement_description

An Arrangement_description gives a general textual description of the ship's spatial arrangement.
The data associated with an Arrangement_description are the following:

— item_descriptions.

The item_descriptions specifies the data sheet for each room or zone (area) in a ship.

4.2.9 Arrangement_item_description

An Arrangement_item_description is a basic description of a space, zone or compartment.
The data associated with an Arrangement_item_description are the following:

— area;

— breadth;

— height;

— identifier;

— length_longitudinal;

— purpose;

— type_of_arrangement_item;

— volume.

4.2.9.1 area

The area specifies the area covered by the arrangement item.

4.2.9.2 breadth

The breadth specifies the expected breadth covered by the arrangement item perpendicular to the length_longitudinal.

4.2.9.3 height

The height specifies the expected height covered by the arrangement item.

4.2.9.4 identifier

The identifier specifies the name for the arrangement_item using an organization or project-specific naming convention, such as the compartment classification system.

4.2.9.5 length_longitudinal

The length_longitudinal specifies the expected length in the longitudinal direction of the ship covered by the arrangement item.

4.2.9.6 purpose

The purpose specifies a description of the purpose of this item, describing intended function and special requirements to be considered during the design phase.

4.2.9.7 type_of_arrangement_item

The type_of_arrangement_item specifies the meaningful name for the arrangement_item using shipbuilding terminology.

EXAMPLE 2 - cargo room, engine room, fore peak, fresh water tank, pantry.

4.2.9.8 volume

The volume specifies the volume of the item described.

EXAMPLE 3 - A tank might have an intended volume of 800 m^3.

4.2.10 Bay_cell_position

A bay_cell_position is a type of Cargo_position (see). It is the position of a unit cargo in a cargo bay in a ship compartment or on deck.

The data associated with a Bay_cell_position are the following:

— bay_number;

— relating_to;

— row;

— tier.

4.2.10.1 bay_number

The bay_number specifies the transverse position of the bay within the bay definition.

4.2.10.2 relating_to

The relating_to specifies the definition of the bay structure of the ship.

4.2.10.3 row

The row specifies the longitudinal position of the bay within the bay definition.

4.2.10.4 tier

The tier specifies the vertical position of the bay within the bay definition.

4.2.11 Bulk_cargo_assignment

A Bulk_cargo_assignment is a type of Compartment_cargo_load (see). It associates a compartment to bulk cargo which has been allocated and loaded into the compartment.

The data associated with a Bulk_cargo_assignment are the following:

— actual_angle_of_repose;

— trimmed.

4.2.11.1 actual_angle_of_repose

The actual_angle_of_repose specifies the actual angle subtended with the horizontal by the upper surface of the conic pile, made by the bulk cargo when loaded into a hold.

4.2.11.2 trimmed

The trimmed specifies whether or not the natural pile of bulk cargo has been flattened and spread out to fill the compartment.

4.2.12 Bulk_cargo

A Bulk_cargo is a type of Dry_cargo (see). It is solid cargo which is not packed but is carried loose, such as grain or coal.

The data associated with a Bulk_cargo are the following:

— natural_angle_of_repose;

— type_of.

4.2.12.1 natural_angle_of_repose

The natural_angle_of_repose specifies the angle naturally subtended with the horizontal by the upper surface of the conic pile, made by the bulk cargo when loaded into a hold.

4.2.12.2 type_of

The type_of specifies the type of bulk_cargo.

The value of the type_of shall be one of the following:

— grain;

— ore;

— coal;

— sugar;

— general;
— cement;
— fish;
— mud;
— timber.

NOTE - See 4.2.12.2.1 - 4.2.12.2.9 for the definition of each allowable value for type_of.

4.2.12.2.1 grain: the bulk cargo consists of grain.

4.2.12.2.2 ore: the bulk cargo consists of ore.

4.2.12.2.3 coal: the bulk cargo consists of coal.

4.2.12.2.4 sugar: the bulk cargo consists of sugar.

4.2.12.2.5 general: the bulk cargo consists of general cargo not specified by name.

4.2.12.2.6 cement: the bulk cargo consists of cement.

4.2.12.2.7 fish: the bulk cargo consists of fish.

4.2.12.2.8 mud: the bulk cargo consists of mud.

4.2.12.2.9 timber: the bulk cargo consists of timber.

4.2.13 Capacity_properties

The Capacity_properties provides measures of volumetric characteristic of a Tank_compartment or Cargo_compartment computed at a specific combination of level, trim, and heel angle. The level represents the imaginary planar surface at the cargo/non-cargo interface and is relative to a capacity level origin established for the compartment. The attitude of the plane is adjusted to coincide with a vector having a magnitude equal to the level and a direction reflecting the vessel's heel and trim. A compartment may have any number of combinations of capacity values.

The data associated with a Capacity_properties are the following:

— capacity_center;
— capacity_context;
— capacity_heel_angle;
— capacity_level;
— capacity_level_origin;
— capacity_trim_angle;
— capacity_volume.

4.2.13.1 capacity_center

The capacity_center specifies the position of the volumetric center of the interior region of space formed by the compartment boundaries and the imaginary plane representing the cargo/non-cargo interface.

4.2.13.2 capacity_context

The capacity_context specifies the values representing the two significant capacity states. The context must be unique with respect to a compartment, capacity level, capacity heel angle, capacity trim angle, and a compartment capacity type.

The value of the capacity_context shall be one of the following:

— percent 100 capacity;
— percent 98 capacity;
— user defined.

NOTE - See 4.2.13.2.1 - 4.2.13.2.3 for the definition of each allowable value for capacity_context.

4.2.13.2.1 percent 100 capacity: the Compartment properties are defined for a full tank.

4.2.13.2.2 percent 98 capacity: the Compartment properties are defined for a 98% full tank.

4.2.13.2.3 user defined: the Compartment properties are defined for a tank filled to a level specified in the inherited user_def_function attribute.

4.2.13.3 capacity_heel_angle

The capacity_heel_angle specifies the amount of rotation about the ship's longitudinal axis that has been factored into the capacity calculation for the plane representing the interface between the cargo and non-cargo regions of the compartment.

4.2.13.4 capacity_level

The capacity_level specifies the distance between the bottom of the compartment (expressed as the capacity_level_origin) and the top of an imaginary plane representing the cargo/non-cargo interface. It is measured along a vector offset from the vertical to reflect the capacity heel angle and the capacity trim angle.

4.2.13.5 capacity_level_origin

The capacity_level_origin specifies the point associated with a Tank_compartment or Cargo_compartment that represents the vertical reference for measuring the capacity depth levels corresponding to a set of compartment capacities. It may be chosen to represent the bottom of the compartment, the bottom of the sounding tube, or any other convenient location.

4.2.13.6 capacity_trim_angle

The capacity_trim_angle specifies the amount of rotation about the ship's transverse centerline axis that has been factored into the capacity calculation for the plane representing the interface between the cargo and non-cargo regions of the compartment.

4.2.13.7 capacity_volume

The capacity_volume specifies the enclosed volumetric measurement of the interior region of space formed by the compartment and the imaginary plane representing the cargo/non-cargo interface.

4.2.14 Cargo_assignment

A cargo_assignment is the allocation of a cargo to a space within a ship. A Cargo_assignment is either a Compartment_cargo_assignment (see) or a Deck_cargo_assignment (see).

The data associated with a Cargo_assignment are the following:

— allocated_weight;

— assignment_context.

4.2.14.1 allocated_weight

The allocated_weight specifies the actual mass of cargo which has been loaded.

4.2.14.2 assignment_context

The assignment_context specifies the intended reason for loading the cargo on the ship.

The value of the assignment_context shall be one of the following:

— cargo;

— stores;

— accomodation;

— unspecified.

NOTE - See 4.2.14.2.1 - 4.2.14.2.4 for the definition of each allowable value for assignment_context.

4.2.14.2.1 cargo: the cargo assignment is a loading of cargo for shipping.

4.2.14.2.2 stores: the cargo assignment is the loading of stores for the use of the passengers and crew on the journey.

4.2.14.2.3 accomodation: the cargo assignment is the loading of furnishings in the accomodation areas of the ship.

4.2.14.2.4 unspecified: the cargo assignment is of no specific type.

NOTE - A value of unspecified can be used for defining theoretical loads for analytical purposes.

4.2.15 Cargo_bay_definition

4.2.16 Cargo_compartment_design_definition

A Cargo_compartment_design_definition is a type of Compartment_design_definition (see) which provides the abstract definition of a version of a Cargo_compartment from a design perspective. The Cargo_compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Cargo_compartment.

The data associated with a Cargo_compartment_design_definition are the following:

— cargo_bay;

— cargo_compartment_properties.

4.2.16.1 cargo_bay

The cargo_bay is optional and, if present, specifies

4.2.16.2 cargo_compartment_properties

The cargo_compartment_properties specifies the references to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Cargo_compartment.

4.2.17 Cargo_compartment_functional_definition

A Cargo_compartment_functional_definition defines the functional role of a Cargo_compartment. The role may be a pre-defined one or may be user-defined.

The data associated with a Cargo_compartment_functional_definition are the following:

— used_for.

The used_for specifies the name of a function that a specific Cargo_compartment may have in a ship.

The value of the used_for shall be one of the following:

— dry bulk cargo;

— dry unit cargo;

— liquid cargo;

— gaseous cargo;

— user defined.

NOTE - See 4.2.17.1 - 4.2.17.5 for the definition of each allowable value for used_for.

4.2.17.1 dry bulk cargo: the Cargo_compartment is designed to carry dry bulk cargo.

4.2.17.2 dry unit cargo: the Cargo_compartment is designed to carry dry unit cargo.

4.2.17.3 liquid cargo: the Cargo_compartment is designed to carry liquid cargo.

4.2.17.4 gaseous cargo: the Cargo_compartment is designed to carry gaseous cargo.

4.2.17.5 user defined: the cargo to be carried in the Cargo_compartment is defined by the inherited user_def_function attribute.

4.2.18 Cargo_compartment_property_set

A Cargo_compartment_property_set is properties for cargo capacities and cargo densities for which the Cargo_compartment is designed.

The data associated with a Cargo_compartment_property_set are the following:

— bulk_cargo_capacity;

— design_stowage_density.

4.2.18.1 bulk_cargo_capacity

The bulk_cargo_capacity is optional and, if present, specifies

4.2.18.2 design_stowage_density

The design_stowage_density specifies the measure of the quantity per unit volume of the dry bulk cargo for which the Cargo_compartment is designed.

4.2.19 Cargo_compartment

A Cargo_compartment is a type of Compartment (see) that is used primarily for the carriage of dry or liquid goods. These goods may be consumed during the voyage, as in the case of food or fuel, or they may be temporarily stored for transport between ports.

NOTE - a Tank_compartment may also be used for the storage or transportation of liquid cargo.

The data associated with a Cargo_compartment are the following:

— roles.

The roles specifies the Cargo_compartment_functional_definition for a cargo compartment.

4.2.20 Cargo_footprint

A Cargo_footprint is the size and position of the area of contact of a Unit_cargo with the deck or support.

The data associated with a Cargo_footprint are the following:

— contact_material;

— position;

— shape;

— transferred_mass.

4.2.20.1 contact_material

The contact_material specifies the type of material which is in contact with the structure.

The value of the contact_material shall be one of the following:

— rubber;

— pneumatic;

— metal;

— other.

NOTE - See 4.2.20.1.1 - 4.2.20.1.4 for the definition of each allowable value for contact_material.

4.2.20.1.1 rubber: the material in contact with the structure is rubber.

4.2.20.1.2 pneumatic: the material in contact with the structure is pneumatic.

4.2.20.1.3 metal: the material in contact with the structure is metal.

4.2.20.1.4 other: the material in contact with the structure is other than rubber, pneumatic, or metal.

4.2.20.2 position

The position specifies the position of the centre of area of the footprint with respect to the Local_coordinate_system of the Unit_cargo.

4.2.20.3 shape

The shape specifies the definition of the shape of the footprint.

4.2.20.4 transferred_mass

The transferred_mass specifies the mass of the Unit_cargo which is transferred to the deck via the footprint.

4.2.21 Cargo_material_properties

The Cargo_material_properties are the physical properties associated with a cargo.

The data associated with a Cargo_material_properties are the following:

— density;

— expansion_coefficient;

— specific_heat_capacity;

— thermal_conductivity;

— viscosity.

4.2.21.1 density

The density specifies the mass per unit volume of the cargo.

4.2.21.2 expansion_coefficient

The expansion_coefficient specifies the coefficient of linear thermal expansion. It is used to define the relationship between expansion and temperature change of the cargo material.

4.2.21.3 specific_heat_capacity

The specific_heat_capacity specifies the amount of energy required to raise the temperature of a Kilogram of cargo material by 1 degree Centigrade.

4.2.21.4 thermal_conductivity

The thermal_conductivity specifies the rate at which the cargo will conduct heat.

4.2.21.5 viscosity

The viscosity specifies the kinematic viscosity of the liquid cargo. When multiplied by the Reynolds number, it gives the fluid velocity over a linear dimension.

4.2.22 Cargo_position

A Cargo_position is the position of a unit cargo in terms of either the bays in a compartment or on the deck of a ship, or by a ship coordinate. A cargo_position shall be either an Absolute_cargo_position (see), a Bay_cell_position (see) or a Lane_definition (see).

4.2.23 Change_impact

A Change_impact defines the effect a Change will cause or has caused.
The data associated with a Change_impact are the following:

— impact.

The impact specifies the effect of a Change in terms of the creation, modification or deletion of one or more Definitions.

4.2.24 Change_plan

A Change_plan defines the proposed solution for a Change. It is the basis for the activities necessary to actually realize the Change.
The data associated with a Change_plan are the following:

— checks;

— impact.

4.2.24.1 checks

The checks specifies the checks planned for the Change.

4.2.24.2 impact

The impact specifies the estimated or calculated effects of the Change. This impact is usually chosen from the set of Change_request solution alternatives.

4.2.25 Change_realization

A Change_realization defines the actual, observed effects of a Change.
The data associated with a Change_realization are the following:

— checks;

— impact.

4.2.25.1 checks

The checks specifies the checks actually performed.

4.2.25.2 impact

The impact specifies the observed effects of the Change.

4.2.26 Change_request

A Change_request is the first phase of a Change, during which the need for a Change and possible solution alternatives are established.
The data associated with a Change_request are the following:

— addressee;
— initiator;
— problem;
— solution_alternatives;
— solution_description.

4.2.26.1 addressee

The addressee specifies the person and organization the request is addressed to. The addressee need not be specified for a particular Change_request.

4.2.26.2 initiator

The initiator specifies the person and organization which originated the request.

4.2.26.3 problem

The problem specifies the textual description of the problem having induced the request.

4.2.26.4 solution_alternatives

The solution_alternatives specifies the alternative solutions envisaged to solve the problem. A solution is described in terms of the created, modified or deleted Definitions, and associated costs.

4.2.26.5 solution_description

The solution_description specifies the textual description of one or more possible solutions for the problem. This textual description should be present, if the solution_alternatives are not yet established, or may enhance the information provided by the solution_alternatives. A solution_description need not be specified for a particular Change_request.

4.2.27 Change

A Change represents the focus of all stages associated with a change affecting one or more definitions. Stages distinguished are as requested, planned and realized.
The data associated with a Change are the following:

— class.

The class specifies the qualification of the organisational role of the change

EXAMPLE 4 - Headquater Modification Request or Engineering Change Proposal are such possible qualifications.

4.2.28 Change_state

A Change_state is the generalization of the major discrete stages of a Change.
The data associated with a Change_state are the following:

— author;
— change_reference;
— date_time.

4.2.28.1 author

The author specifies the person and organization responsible for the change activities during the period lasting from the end of the previous state (if it exists) to the end of this Change_state.

4.2.28.2 change_reference

The change_reference specifies the Change the data of the Change_state is referring to.

4.2.28.3 date_time

The date_time specifies the date and time when this state was reached.

4.2.29 Check

A Check defines the details of a planned or fulfilled control activity.

4.2.30 Coating_certification

A Coating_certification is identification of the organisation that has certified a coating, and time limit on the certification of a coating for usage.
The data associated with a Coating_certification are the following:

— certifying_organisation;
— expiry_date.

4.2.30.1 certifying_organisation

The certifying_organisation specifies the organsation which certified the coating for use.

4.2.30.2 expiry_date

The expiry_date specifies specifies the time limit on the approval.

4.2.31 Coating_level

The Coating_level is the extent of coating in a tank compartment.
The data associated with a Coating_level are the following:

— lower_extent;
— upper_extent.

4.2.31.1 lower_extent

The lower_extent specifies the the percentage of the height from the base of the Compartment to the lowest level of the coating.

4.2.31.2 upper_extent

The upper_extent specifies the the percentage of the height from the base of the Compartment to the highest level of the coating.

4.2.32 Coating

A Coating is the definition of the protective coating applied to the ship structure to protect it from corrosion from water or cargos.
The data associated with a Coating are the following:

— certification;
— description;
— dry_film_thickness;
— manufacturer;
— name;
— number_of_coats;
— surface_preparation.

4.2.32.1 certification

The certification specifies whether the coating, and all the given attributes, have been certified for the specified use by an organisation such as a Classification Society.

4.2.32.2 description

The description specifies a brief description of the coating.

4.2.32.3 dry_film_thickness

The dry_film_thickness specifies the thickness of the coating film.

4.2.32.4 manufacturer

The manufacturer specifies the company which makes the coating.

4.2.32.5 name

The name specifies the trade name of the coating.

4.2.32.6 number_of_coats

The number_of_coats specifies the number of coats which must be applied to the surface.

4.2.32.7 surface_preparation

The surface_preparation specifies the codes used for the grade of preparation required for steel surfaces prior to application of coating. These are according to ISO 8501-1.
The value of the surface_preparation shall be one of the following:

— Sa3;
— Sa2 5.

NOTE - See 4.2.32.7.1 - 4.2.32.7.2 for the definition of each allowable value for surface_preparation.

4.2.32.7.1 Sa3:

4.2.32.7.2 Sa2 5:

4.2.33 Compartment_areas

The Compartment_areas is the collection of cross section and surface area properties for a Compartment.
The data associated with a Compartment_areas are the following:

- horizontal_cross_sectional_area;
- stiffened_surface_area;
- unstiffened_surface_area;
- vertical_longitudinal_cross_sectional_area;
- vertical_transverse_cross_sectional_area.

4.2.33.1 horizontal_cross_sectional_area

The horizontal_cross_sectional_area specifies the area measurement on a plane parallel to the baseline plane.
NOTE - Typically, the area is used to reserve space early in the design process, such as the area needed for placement of a propulsion system footprint (i.e. main engine, reduction gear, etc.).

4.2.33.2 stiffened_surface_area

The stiffened_surface_area specifies the measure of the amount of surface area for the compartment, including the surface area of any interior stiffeners on the bulkheads, decks, or hull shell.

4.2.33.3 unstiffened_surface_area

The unstiffened_surface_area specifies the measure of the amount of surface area for the compartment, excluding the surface area of any interior stiffeners on the bulkheads, decks, or hull shell.

4.2.33.4 vertical_longitudinal_cross_sectional_area

The vertical_longitudinal_cross_sectional_area specifies the area measurement corresponding to a plane defined by the vertical and longitudinal axes.
NOTE - Typically, this area is used to reserve space early in the design process, such as the area needed for placement of a large piece of equipment.

4.2.33.5 vertical_transverse_cross_sectional_area

The vertical_transverse_cross_sectional_area specifies the area measurement corresponding to a plane defined by the vertical and transverse axes.
NOTE - Typically, this area is used to reserve space early in the design process, such as the area needed for placement of a large piece of equipment.

4.2.34 Compartment_cargo_assignment

A Compartment_cargo_assignment is a type of Cargo_assignment (see). It is the allocation of cargo to a compartment or space within a ship. A compartment_cargo_assignment shall be either a Liquid_cargo_assignment (see), a Bulk_cargo_assignment (see) or a Unit_cargo_assignment (see).
The data associated with a Compartment_cargo_assignment are the following:

- cargo;
- compartment.

4.2.34.1 cargo

The cargo specifies the type of cargo which has been loaded.

4.2.34.2 compartment

The compartment specifies the compartment into which the cargo has been loaded.

4.2.35 Compartment_design_definition

A Compartment_design_definition is the abstract definition of a version of a Compartment from a design perspective. The Compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Compartment.
The data associated with a Compartment_design_definition are the following:

— applicable_cargos;
— design_requirements;
— properties;
— representation.

4.2.35.1 applicable_cargos

The applicable_cargos specifies the consumables or cargoes applicable for a particular Compartment.
NOTE - Cargo includes all types of stowed items, spares, consumables used during a voyage, and passengers and crew with their belongings, in addition to transported products.

4.2.35.2 design_requirements

The design_requirements specifies the reference to a description or formal specification that represents a constraint placed on the design.

4.2.35.3 properties

The properties specifies the reference to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Compartment.

4.2.35.4 representation

The representation specifies the Compartment_shape_ representation that defines the geometric shape of the compartment.

4.2.36 Compartment_group

A Compartment_group defines the compartment and its associated volume which has been used in Tonnage calculations.
The data associated with a Compartment_group are the following:

— compartment;
— tonnage_volume.

4.2.36.1 compartment

The compartment specifies the compartment or group of compartments which was used in the tonnage calculation.

4.2.36.2 tonnage_volume

The tonnage_volume specifies the volume of the compartment which was used for the tonnage calculation.

4.2.37 Compartment_naval_administrative_properties

The Compartment_naval_administrative_properties is a collection of identification and compartment design parameters that are applicable only to the design of Naval vessels.
The data associated with a Compartment_naval_administrative_properties are the following:

— authorization_classification;
— compartment_abbreviated_name;
— department_ziplist_number;
— division_ziplist_number;
— insulation_category;
— maximum_accleration_g_force;
— noise_category;
— nuclear_classification;
— safety_category;
— security_classification.

4.2.37.1 authorization_classification

The authorization_classification specifies the type of crew restriction placed on the use of the compartment.
The value of the authorization_classification shall be one of the following:

— officers only;
— crew only;
— restricted;

— unrestricted;
— user defined.

NOTE - See 4.2.37.1.1 - 4.2.37.1.5 for the definition of each allowable value for authorization_classification.

4.2.37.1.1 officers only: the Compartment is designated for use by officers.

4.2.37.1.2 crew only: the Compartment is designated for use by crew.

4.2.37.1.3 restricted: the Compartment is designated as a restricted area.

4.2.37.1.4 unrestricted: the Compartment access is not limited to any particular group.

4.2.37.1.5 user defined: the use of the Compartment is defined by the inherited user_def_function attribute.

4.2.37.2 compartment_abbreviated_name

The compartment_abbreviated_name specifies a short, compact, efficient means of referring to a particular compartment on a ship. The abbreviated name may or may not have an embedded meaning.

NOTE - In U.S. Naval vessels, abbreviated names are commonly used and are encoded such that they indicate the type of cargo, and the vertical, transverse, and longitudinal position, such as the abbreviation of 6-55-1F for the freshwater tank above the 6th deck, beginning at frame 55, and located on the starboard side.

4.2.37.3 department_ziplist_number

The department_ziplist_number specifies the organization-specific identifier used for departmental control over the compartment during an overhaul or repair availability.

4.2.37.4 division_ziplist_number

The division_ziplist_number specifies the organization-specific identifier used for division control over the compartment during an overhaul or repair availability.

4.2.37.5 insulation_category

The insulation_category specifies the indicator used to denote what type of consideration is to be given to the compartment with regard to its thermal conductivity.

The value of the insulation_category shall be one of the following:

— A;
— B;
— C;
— D;
— E;
— F;
— G;
— H;
— I;
— J.

NOTE - See 4.2.37.5.1 - 4.2.37.5.10 for the definition of each allowable value for insulation_category.

4.2.37.5.1 A: the Compartment shall be designed for a specific temperature range and/or compartment type**.**

4.2.37.5.2 B: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.3 C: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.4 D: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.5 E: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.6 F: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.7 G: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.8 H: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.9 I: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.5.10 J: the Compartment shall be designed for a specific temperature range and/or compartment type.

4.2.37.6 maximum_accleration_g_force

The maximum_accleration_g_force specifies the measure of the maximum allowable acceleration force, expressed as a ratio compared to the force of gravity, allowed for a compartment. This force is represented as a single value and governs the accelerations in all three principal directions, vertical, longitudinal, and transverse.

EXAMPLE 5 - A value of 1.5 would represent one-and-a-half times the force of gravity (32.2 ft/sec2), or 48.3 ft/sec2.

4.2.37.7 noise_category

The noise_category specifies the single alphabetical character key used to denote whether special consideration is to be given to the compartment with respect to the internal level of sound.

The value of the noise_category shall be one of the following:

— A;
— B;
— C;
— D;
— E;
— F.

NOTE - See 4.2.37.7.1 - 4.2.37.7.6 for the definition of each allowable value for noise_category.

4.2.37.7.1 A: the Compartment shall be designed for intelligible speech - low noise.

4.2.37.7.2 B: the Compartment shall be designed for comfort.

4.2.37.7.3 C: the Compartment shall be designed for quiet**.**

4.2.37.7.4 D: the Compartment shall be designed for deafness avoidance.

4.2.37.7.5 E: the Compartment shall be designed for intelligible speech - high noise.

4.2.37.7.6 F: the Compartment shall be designed for intelligible speech - topside.

NOTE - For a more complete treatment of noise categories, see [ ].

4.2.37.8 nuclear_classification

The nuclear_classification specifies the indicator used to denote whether the compartment is designated a nuclear or non-nuclear space. This designation applies to spaces specifically designed to contain such things as nuclear reactors as well as spaces used for the storage or repair of nuclear weapons.
The value of the nuclear_classification shall be one of the following:

— nuclear;

— non nuclear.

NOTE - See 4.2.37.8.1 - 4.2.37.8.2 for the definition of each allowable value for nuclear_classification.

4.2.37.8.1 nuclear: the Compartment contains nuclear propulsion systems or is used for storage or repair of nuclear weapons.

4.2.37.8.2 non nuclear: the Compartment does not contain nuclear propulsion systems nor is it used for storage or repair of nuclear weapons.

4.2.37.9 safety_category

The safety_category specifies the indicator used to denote special consideration for the compartment with regard to a hazardous working environment for humans.
The value of the safety_category shall be one of the following:

— a;

— b;

— c.

NOTE - See 4.2.37.9.1 - 4.2.37.9.3 for the definition of each allowable value for safety_category.

4.2.37.9.1 a: the Compartment is designated as safety class a.

4.2.37.9.2 b: the Compartment is designated as safety class b.

4.2.37.9.3 c: the Compartment is designated as safety class c.

NOTE - For a more complete treatment of safety categories, see [ ].

4.2.37.10 security_classification

The security_classification specifies the indicator used to denote special considerations for the compartment with respect to accessibility and security clearances.
The value of the security_classification shall be one of the following:

— unclassified;

— classified;

— secret.

NOTE - See ? - ? for the definition of each allowable value for security_classification.

4.2.37.10.1 unclassified: the Compartment is designated for unclassified access.

4.2.37.10.2 classified: the Compartment is designated for classified access.

4.2.37.10.3 secret: the Compartment is designated for secret access.

4.2.38 Compartment_permeability

The Compartment_permeability is a measure, expressed as a percentage of the volume or footprint area of the compartment, representing open space (i.e. not occupied by equipment, structure, machinery, etc.) that would flood in the event the space's watertight integrity was damaged. These are key parameters for the damage stability calculations for a ship.
The data associated with a Compartment_permeability are the following:

— area_permeability;

— volume_permeability.

4.2.38.1 area_permeability

The area_permeability specifies the percentage of the occupied surface of a Compartment.

4.2.38.2 volume_permeability

The volume_permeability specifies the percentage of the occupied space of a Compartment.

4.2.39 Compartment_property_set

The Compartment_property_set is a collection of properties for a compartment. A property is a measure of some significant characteristic of a compartment associated with a specific context and the type of Compartment. The contexts may be either maximum, minimum, estimated, calculated, or measured. A compartment may have multiple property sets; however, a property set must be unique with respect to the compartment property context, and compartment. A Compartment_property_set may be a General_compartment_property_set (see), a Cargo_compartment_property_set (see), Habitable_compartment_property_set (see), Machinery_compartment_property_set (see), a Tank_compartment_property_set (see), or a Void_compartment_property_set (see).

The data associated with a Compartment_property_set are the following:

— context.

The context specifies an indicator used to associate a design meaning with a compartment property set. The value of the context shall be one of the following:

— maximum;

— minimum;

— estimated;

— calculated;

— measured.

NOTE - See 4.2.39.1.1 - 4.2.39.1.5 for the definition of each allowable value for context.

4.2.39.1.1 maximum: the Compartment_property_set specifies the maximum design values for the various properties.

4.2.39.1.2 minimum: the Compartment_property_set contains the minimum design values for the various properties.

4.2.39.1.3 estimated: the Compartment_property_set contains the estimated design values for the various properties.

4.2.39.1.4 calculated: the Compartment_property_set contains the calculated design values for the various properties.

4.2.39.1.5 measured: the Compartment_property_set contains the measured as-built values for the various properties.

4.2.40 Compartment_shape_representation_2d

4.2.41 Compartment_shape_representation_3d

The Compartment_shape_representation_3d is the 3D representation of the shape of a compartment, constructed by referencing the moulded form regions that form the bounding surfaces for the compartment.

The data associated with a Compartment_shape_representation_3d are the following:

— compartment_boundaries.

The compartment_boundaries specifies the moulded form regions surrounding the compartment.

4.2.42 Compartment_shape_representation

4.2.43 Compartment

A Compartment is a physical subdivision of space on a ship, designed to hold dry or liquid cargo, fuel, water, passengers, crew, machinery, or equipment. Each Compartment may have one or more design definitions, which specify the compartment's boundaries as well as its physical and geometric properties. Each Compartment is also an Item_structure, which references the items bounding a compartment, such as moulded form regions or structural panels, or enclosed by a compartment, such as structural parts, outfitting objects, and equipment objects.

4.2.44 Compartment_volume

The Compartment_volume describes the volume properties of a Compartment.

The data associated with a Compartment_volume are the following:

— centre_of_volume;

— volume.

4.2.44.1 centre_of_volume

The centre_of_volume specifies the centre_of_volume of a Compartment in relation to the global co-ordinate system of the ship.

4.2.44.2 volume

The volume specifies the volume of a Compartment.

4.2.45 Compensated_gross_tonnage

A Compensated_gross_tonnage represents an estimated figure for gross tonnage, which reflects the complexity of the work involved in the construction of the ship.
The data associated with a Compensated_gross_tonnage are the following:

— compensation_factor;

— gross_tonnage_measurement;

— tonnage_value.

4.2.45.1 compensation_factor

The compensation_factor specifies the multiplication factor applied to the Gross_tonnage value in order to obtain the compensated_gross_tonnage The compensation factor is derived by the Association of West European Shipyards and the Shipbuilding Association of Japan, and varies according to the type of ship, deadweight (for cargo ships) and gross tonnage (for passenger ships). For any particular shiptype, the compensation factor decreases with increasing ship size - the larger the ship, the smaller the man-hour requirement per gross tonnage.

4.2.45.2 gross_tonnage_measurement

The gross_tonnage_measurement specifies the Gross_tonnage measurement which the compensated figure is based on

4.2.45.3 tonnage_value

The tonnage_value specifies the

4.2.46 Corrosion_control_coating

The Corrosion_control_coating is the type and applicability of coating to be used for corrosion control.
The data associated with a Corrosion_control_coating are the following:

— applicability;

— primer;

— type_of.

4.2.46.1 applicability

The applicability specifies the circumstances where the coating can be used.
The value of the applicability shall be one of the following:

— C;

— RS;

— B;

— V.

NOTE - See ? - ? for the definition of each allowable value for applicability.

4.2.46.1.1 C: the coated surface is suitable for transport of crude oil.

4.2.46.1.2 RS: the coated surface is suitable for transport of refined spirits.

4.2.46.1.3 B: the coated surface is suitable for ballast water.

4.2.46.1.4 V: the coated surface is suitable for void spaces.

4.2.46.2 primer

The primer specifies the Primer_coating which is required by the Corrosion_control_coating.

4.2.46.3 type_of

The type_of specifies the class of the coating.

The value of the type_of shall be one of the following:

- aluminium;
- bituminous;
- chlorinated rubber;
- coal tar;
- epoxy;
- glassflake;
- isocynate;
- micaceous iron oxide;
- non oxidising;
- phenolic;
- pitch;
- polyester;
- polyurethane;
- tar;
- vinyl;
- water based;
- zinc rich;
- zinc silicate.

NOTE - See 4.2.46.3.1 - 4.2.46.3.18 for the definition of each allowable value for type_of.

4.2.46.3.1 aluminium: the corrosion control coating specified is aluminium.

4.2.46.3.2 bituminous: the corrosion control coating specified is bituminous.

4.2.46.3.3 chlorinated rubber: the corrosion control coating specified is chlorinated rubber.

4.2.46.3.4 coal tar: the corrosion control coating specified is coal tar.

4.2.46.3.5 epoxy: the corrosion control coating specified is epoxy.

4.2.46.3.6 glassflake: the corrosion control coating specified is glassflake.

4.2.46.3.7 isocynate: the corrosion control coating specified is isocynate.

4.2.46.3.8 micaceous iron oxide: the corrosion control coating specified is micaceous iron oxide.

4.2.46.3.9 non oxidising: the corrosion control coating specified is non-oxidising.

4.2.46.3.10 phenolic: the corrosion control coating specified is phenolic.

4.2.46.3.11 pitch: the corrosion control coating specified is pitch.

4.2.46.3.12 polyester: the corrosion control coating specified is polyester.

4.2.46.3.13 polyurethane: the corrosion control coating specified is polyurethane.

4.2.46.3.14 tar: the corrosion control coating specified is tar.

4.2.46.3.15 vinyl: the corrosion control coating specified is vinyl.

4.2.46.3.16 water based: the corrosion control coating specified is water based.

4.2.46.3.17 zinc rich: the corrosion control coating specified is zinc rich.

4.2.46.3.18 zinc silicate: the corrosion control coating specified is zinc silicate.

4.2.47 Corrosion_protection

The Corrosion_protection is a collection of properties for protecting compartment internals and boundaries from corrosion.

The data associated with a Corrosion_protection are the following:

— cathodic_protection;
— coating_height;
— coating_material.

4.2.47.1 cathodic_protection

The cathodic_protection specifies whether cathodic corrosion protection is applicable or not for a compartment. A cathodic_protection need not be specified for a particular Corrosion_protection.

4.2.47.2 coating_height

The coating_height specifies the range of coating of the compartment or tank. A coating_height need not be specified for a particular Corrosion_protection.

EXAMPLE 6 - A tank would be coated from 80% to 90%.

4.2.47.3 coating_material

The coating_material specifies the material that is to be used to coat the steel making up the compartment boundaries. A coating_material need not be specified for a particular Corrosion_protection.

4.2.48 Curve

A Curve is a type of Geometric_representation_item (see **Error! Reference source not found.**). A curve is set of mathematical points which is the image, in two or three-dimensional space, of a continuous function defined over a connected subset of the real line, and which is not a single point. The specific geometry that is allowed for Curve is described by the following subtypes:

— bounded_curve;
— conic;
— curve_replica;
— line;
— offset_curve_3D;
— pcurve;
— Ship_curve (see).
— surface_curve.

4.2.49 Dangerous_goods_code

The Dangerous_goods_code is the nature of the danger associated with the specific cargo as specified by the International Maritime Dangerous Goods code and the International Convention for the Safety of Life at Sea, 1974 Chapter VII, Part A.

The data associated with a Dangerous_goods_code are the following:

— class;
— subsidiary_risks.

4.2.49.1 class

The class specifies the primary hazard class of the cargo.

The value of the class shall be one of the following:

— class 1;
— class 21;
— class 22;
— class 23;
— class 3;
— class 41;
— class 42;
— class43;
— class 51;
— class 52;
— class 61;
— class 62;

— class 71;
— class 72;
— class 73;
— class 8;
— class 9.

NOTE - See 4.2.48.1.1 - 4.2.48.1.17 for the definition of each allowable value for class.

4.2.49.1.1 class 1: the cargo is Explosive.

4.2.49.1.2 class 21: the cargo is a Flammable Gas**.**

4.2.49.1.3 class 22: the cargo is a Non-flammable Compressed Gas.

4.2.49.1.4 class 23: the cargo is a Poisonous Gas.

4.2.49.1.5 class 3: the cargo is a Flammable Liquid.

4.2.49.1.6 class 41: the cargo is a Flammable Solid.

4.2.49.1.7 class 42: the cargo is a substance likely to spontaneously combust.

4.2.49.1.8 class 43: the cargo will emit Flammable Gas when in Contact with Water.

4.2.49.1.9 class 51: the cargo is an Oxidising Agent.

4.2.49.1.10 class 52: the cargo is an Organic Peroxide.

4.2.49.1.11 class 61: the cargo is Toxic.

4.2.49.1.12 class 62: the cargo is an Infectious Substance.

4.2.49.1.13 class 71: the cargo is a Category I Radioactive Substance.

4.2.49.1.14 class 72: the cargo is a Category II Radioactive Substance.

4.2.49.1.15 class 73: the cargo is a Category III Radioactive Substance.

4.2.49.1.16 class 8: the cargo is Corrosive.

4.2.49.1.17 class 9: the cargo is a Miscellaneous dangerous substance. It is any other substance which experience has shown, or may show, to be of such a dangerous character that the provisions of Chapter VII, Part A of SOLAS 1974 shall apply to it.

4.2.49.2 subsidiary_risks

The subsidiary_risks specifies the additional risks associated with the cargo.
The value of the subsidiary_risks shall be one of the following:

— class 1;
— class 21;
— class 22;
— class 23;
— class 3;
— class41;
— class 42;
— class 43;
— class 51;
— class 52;
— class 61;
— class 62;
— class 71;
— class 72;
— class 73;
— class 8;

— class9.

NOTE - See 4.2.48.2.1 - 4.2.48.2.17 for the definition of each allowable value for subsidiary_risks.

4.2.49.2.1 class 1: the cargo is Explosive.

4.2.49.2.2 class 21: the cargo is a Flammable Gas.

4.2.49.2.3 class 22: the cargo is a Non-flammable Compressed Gas.

4.2.49.2.4 class 23: the cargo is a Poisonous Gas.

4.2.49.2.5 class 3: the cargo is a Flammable Liquid.

4.2.49.2.6 class 41: the cargo is a Flammable Solid.

4.2.49.2.7 class 42: the cargo is a substance likely to spontaneously combust.

4.2.49.2.8 class 43: the cargo will emit Flammable Gas when in Contact with Water.

4.2.49.2.9 class 51: the cargo is an Oxidising Agent.

4.2.49.2.10 class 52: the cargo is an Organic Peroxide.

4.2.49.2.11 class 61: the cargo is Toxic.

4.2.49.2.12 class 62: the cargo is an Infectious Substance.

4.2.49.2.13 class 71: the cargo is a Category I Radioactive Substance.

4.2.49.2.14 class 72: the cargo is a Category II Radioactive Substance.

4.2.49.2.15 class 73: the cargo is a Category III Radioactive Substance.

4.2.49.2.16 class 8: the cargo is Corrosive.

4.2.49.2.17 class 9: the cargo is a Miscellaneous dangerous substance. It is any other substance which experience has shown, or may show, to be of such a dangerous character that the provisions of Chapter VII, Part A of SOLAS 1974 shall apply to it.

4.2.50 Deadweight

A deadweight is the weight of the passengers, crew, cargo, stores, ballast, fresh water, fuel oil, and other comsumables being carried by a ship.

The data associated with a Deadweight are the following:

— deadweight_items;

— deadweight_value.

4.2.50.1 deadweight_items

The deadweight_items specifies the items on the ship which constitute the deadweight measurement.

4.2.50.2 deadweight_value

The deadweight_value specifies the mass value of the deadweight.

4.2.51 Deck_cargo_assignment

A Deck_cargo_assignment is a type of Cargo_assignment (see) and is the allocation of unit cargo to spaces on the deck of a ship.

The data associated with a Deck_cargo_assignment are the following:

— cargo;

— position.

4.2.51.1 cargo

The cargo specifies the type of unit cargo which has been loaded on to the deck.

4.2.51.2 position

The position specifies the position on the deck where the cargo has been loaded.

4.2.52 Definition_change_event

A Definition_change_event is the generalization of the events effectively changing a Definition.

4.2.53 Definition_creation

A Definition_creation is the event leading to a new Definition.
The data associated with a Definition_creation are the following:

— base;

— subject.

4.2.53.1 base

The base specifies the Definitions the subject is derived from.

4.2.53.2 subject

The subject specifies the Definition created by the change event.

4.2.54 Definition_deletion

A Definition_deletion is the event leading to the deletion of a Definition.
The data associated with a Definition_deletion are the following:

— subject.

The subject specifies the Definition deleted or to be deleted by the change event.

4.2.55 Definition_modification

A Definition_modification is the event leading to a change of a Definition.
The data associated with a Definition_modification are the following:

— subject.

The subject specifies the Definition modified or to be modified by the change event.

4.2.56 Definition_relationship

The Definition_relationship provides the possibility to relate two Definitions.
The data associated with a Definition_relationship are the following:

— definition_1;

— definition_2;

— description.

4.2.56.1 definition_1

The definition_1 specifies one of the related Definitions.

4.2.56.2 definition_2

The definition_2 specifies one of the related Definitions.

4.2.56.3 description

The description specifies a textual description of the relationship between the two Definitions. The description need not be specified for a particular Definition_relationship.

4.2.57 Definition

A Definition is a life-cycle dependent specification for an item. A Definition shall be either a
The data associated with a Definition are the following:

— defined_for;

— local_units;

— version_id.

4.2.57.1 defined_for

The defined_for specifies the item or item_structure for which a Definition is defined.

4.2.57.2 local_units

The local_units specifies the units that a definition makes use of if different from the ones globally defined for the ship.

4.2.57.3 version_id

The version_id provides simple version control. The version_id need not be specified for a particular Definition.

4.2.58 Design_definition

A Design_definition is a design life-cycle specific view for specification of appropriate attributes and properties of an Item.

The data associated with a Design_definition are the following:

— representations.

The representations specifies the various types of geometric or non-geometric representations applicable for the design definition of an Item.

4.2.59 Design_requirement

A Design_requirement is a type of specification that represents a constraint placed on a design. These requirements could be in the form of a reference to a set of rules or formula, such as NAVSEA Design Specifications, American Bureau of Shipping Rules, American Welding Society Rules, etc. or may be an explicit requirement, such as an electrical requirement for 110 volt power, an HVAC requirement for operating tempuratures in the range of 50^{o} F to 90^{o} F.

The data associated with a Design_requirement are the following:

— requirement_description;

— requirement_type.

4.2.59.1 requirement_description

The requirement_description specifies the textual description of the requirement that is to be met.

4.2.59.2 requirement_type

The requirement_type specifies the indicator used to denote the source placing the design requirement on the space.

The value of the < requirement_type> shall be one of the following:

— naval architecture;

— structural;

— piping;

— hvac;

— electrical;

— electronic;

— combatsystem;

— outfit furnishing;

— painting coating;

— user defined.

NOTE - See 4.2.58.2.1 - 4.2.58.2.10 for the definition of each allowable value for requirement_type.

4.2.59.2.1 naval architecture: the Compartment design requirement originates from the naval_architecture discipline.

4.2.59.2.2 structural: the Compartment_design_requirement originates from the structural discipline.

4.2.59.2.3 piping: the Compartment_design_requirement originates from the piping discipline.

4.2.59.2.4 hvac: the Compartment_design_requirement originates from the hvac discipline.

4.2.59.2.5 electrical: the Compartment_design_requirement originates from the electrical discipline.

4.2.59.2.6 electronic: the Compartment_design_requirement originates from the electronic discipline.

4.2.59.2.7 combat system: the Compartment_design_requirement originates from the combat_system discipline.

4.2.59.2.8 outfit furnishing: the Compartment_design_requirement originates from the outfit_furnishing discipline.

4.2.59.2.9 painting coating: the Compartment_design_requirement originates from the painting_coating discipline.

4.2.59.2.10 user defined: the Compartment_design_requirement is defined by the user.

4.2.60 Displacement

A Displacement is a volume measurement of water displaced by a Moulded_form or Hydrostatic_element when it is immersed to a specified Floating_position.

The data associated with a Displacement are the following:

— displacement_volume.

The displacement_volume specifies the volume of the water displaced by the immersed Moulded_form.

4.2.61 Document_reference

A Document_reference is the qualification of a Document in terms of its source or location.

4.2.62 Document

A Document is an unambigous identification of some human readable data item defined outside ISO 10303.

4.2.63 Document_usage_constraint

A Document_usage_constraint is the applicability of a Document. Applicability may be defined in terms of selecting a specific part of a document or constraining or interpreting the content of that specific part.

4.2.64 Dry_cargo

A Dry_cargo is a type of Ship_cargo (see). It is cargo which is not in liquid or gaseous form. It shall be either a Bulk_cargo (see) or a Unit_cargo (see).

The data associated with a Dry_cargo are the following:

— permeability;

— stowage_factor.

4.2.64.1 permeability

The permeability specifies the amount by which the cargo takes up water.

4.2.64.2 stowage_factor

The stowage_factor specifies the amount of space which a weight of cargo occupies for the purpose of stowage in a compartment, in units of m^3 per tonne).

4.2.65 Envisaged_definition_creation

An Envisaged_definition_creation is the event leading to a new Definition. The event is an envisaged event and has not yet happened. The Definition as the subject of the event does not yet exist and is described in

terms of descriptive, non-formal properties.
The data associated with an Envisaged_definition_creation are the following:

— base;
— definition_category;
— definition_description.

4.2.65.1 base

The base specifies the Definitions the envisaged definition is derived from.

4.2.65.2 definition_category

The definition_category specifies the category the envisaged definition belongs to.

4.2.65.3 definition_description

The definition_description specifies the textual description of the significant features of the envisaged definition.

4.2.66 Event

An Event identifies that something has happened at a certain time, activated by a certain person for a certain reason.
The data associated with an Event are the following:

— caused_by;
— caused_when;
— description.

4.2.66.1 caused_by

The caused_by specifies the person creating the Event.

4.2.66.2 caused_when

The caused_when specifies the date and time, the Event occured.

4.2.66.3 description

The description is optional and, if present, specifies the textural description of significant features, reason of the Event.

4.2.67 External_reference_inside_source

An External_reference_inside_source is an External_reference with a pointer to a location inside the source. If source is a book, the pointer could be a section label or a page number.
The data associated with an External_reference_inside_source are the following:

— line_number;
— page;
— paragraph;
— section.

4.2.67.1 line_number

The line_number specifies a line number in the source document. The line_number need not be specified for a particular External_reference_inside_source.

4.2.67.2 page

The page specifies a page number in the source document. The page need not be specified for a particular External_reference_inside_source.

4.2.67.3 paragraph

The paragraph specifies a paragraph identifier in the source document. The paragraph need not be specified for a particular External_reference_inside_source.

4.2.67.4 section

The section specifies a section label in the source document. The section need not be specified for a particular External_reference_inside_source.

4.2.68 External_reference

An External_reference is the abstract denotion of a data source external to the data set where an instance of

this entity exists.

EXAMPLE 7 - a WWW uniform resource locator denotes such a data source.

The data associated with an External_reference are the following:

— description;

— location;

— source;

— source_type.

4.2.68.1 description

The description specifies additional textual information about the source.

4.2.68.2 location

The location specifies the the location of an external source. In the case of a Universal_resource_locator, this is a computer accessible by a specified transmission protocol.

4.2.68.3 source

The source specifies an identifier for the source.

4.2.68.4 source_type

The source_type specifies the type of printed document or electronic file.

4.2.69 Fire_safe_coating

A Fire_safe_coating is the type and applicability of coating to be used for fire control.

The data associated with a Fire_safe_coating are the following:

— low_flame_spread;

— nitro_cellulose_based;

— primer.

4.2.69.1 low_flame_spread

The low_flame_spread specifies whether the coating has low flame spread characteristics, as specified by BS476:Part7 or other equivalent standards.

4.2.69.2 nitro_cellulose_based

The nitro_cellulose_based specifies whether the coating has a nitro-cellulose or other highly inflammable base.

4.2.69.3 primer

The primer specifies the Primer_coating which is required by the Fire_safe_coating

4.2.70 Floating_position

A Floating_position is the draught and attitude of the ship hull when immersed, and the resulting displacement volume

The data associated with a Floating_position are the following:

— angle_of_heel;

— angle_of_trim;

— draught;

— moulded_form_displacement.

4.2.70.1 angle_of_heel

The angle_of_heel specifies the displacement angle of rotation of the centreplane of the ship measured in radians and measured about a line parallel to the global X-axis that is level to the waterplane. The angle of heel is equal to zero when the centreplane is perpendicular to the waterplane. The angle_of_heel has positive values corresponding to heel of the ship to starboard. The angle_of_heel need not be specified for a particular Floating_position

4.2.70.2 angle_of_trim

The angle_of_trim specifies the displacement angle of rotation of the transverse cross-section at amidships measured in radians and measured about a line parallel to the global Y-axis that is level to the waterplane. The angle_of_trim is equal to zero when the transverse cross-section is perpendicular to the waterplane. The angle_of_trim has positive values corresponding to trim by the bow of the ship. The angle_of_trim need not

be specified for a particular Floating_position

4.2.70.3 draught

The draught specifies the length of the perpendicular from the waterplane to the moulded bottom of the ship, measured at the centreline on the transverse cross-section at amidships

4.2.70.4 moulded_form_displacement

The moulded_form_displacement specifies the Displacement for the given draught, angle_of_trim, and angle_of_heel.

4.2.71 Functional_definition

A Functional_definition is an early life-cycle view of requirements for attributes, properties, or performance of a product.

The data associated with a Functional_definition are the following:

— the_function;

— user_def_function.

4.2.71.1 the_function

The the_function specifies the intended function of the Item. Each specialization of Functional_definition may add additional allowable values of this attribute to specify particular functional requirements.

The value of the the_function shall be one of the following:

— user defined.

NOTE - See 4.2.70.1.1 for the definition of each allowable value for the_function.

4.2.71.1.1 user defined: the function is defined by the label in the user_def_function attribute.

4.2.71.2 user_def_function

The user_def_function specifies the possible functions for the specialized Item.. In the case where the string value of the the_function attribute is “user_defined”, the user_def_function attribute is used to specify the user defined function.

4.2.72 Gaseous_cargo

A Gaseous_cargo is a type of Ship_cargo (see). It is any cargo whose natural condition is a non-solid, non-liquid gaseous state.

The data associated with a Gaseous_cargo are the following:

— required_carriage_pressure;

— type_of.

4.2.72.1 required_carriage_pressure

The required_carriage_pressure specifies the required pressure of the compartment in which the cargo is to be carried.

4.2.72.2 type_of

The type_of specifies the type of the gaseous cargo.

The value of the type_of shall be one of the following:

— acetaldehyde;

— anhydrousammonia;

— avcat;

— butane;

— butadiene;

— butylene;

— diethyl ether;

— dimethylamine;

— ethylene;

— ethyl chlorine;

— ethylene oxide;

— isoprene;
— isopropylamine;
— methane;
— methylchloride;
— monoethylamine;
— naptha;
— propane;
— propane butane mix;
— propylene oxide;
— propylene;
— vinyl ethyl ether;
— vinyl chloridemonomer.

NOTE - See 4.2.71.2.1 -4.2.71.2.23 for the definition of each allowable value for type_of.

4.2.72.2.1 acetaldehyde: the gaseous cargo is acetaldehyde.

4.2.72.2.2 anhydrous ammonia: the gaseous cargo is anhydrous_ammonia.

4.2.72.2.3 avcat: the gaseous cargo is avcat.

4.2.72.2.4 butane: the gaseous cargo is butane.

4.2.72.2.5 butadiene: the gaseous cargo is butadiene.

4.2.72.2.6 butylene: the gaseous cargo is butylene.

4.2.72.2.7 diethyl ether: the gaseous cargo is diethyl_ether.

4.2.72.2.8 dimethylamine: the gaseous cargo is dimethylamine.

4.2.72.2.9 ethylene: the gaseous cargo is ethylene.

4.2.72.2.10 ethyl chlorine: the gaseous cargo is ethyl_chlorine.

4.2.72.2.11 ethylene oxide: the gaseous cargo is ethylene_oxide.

4.2.72.2.12 isoprene: the gaseous cargo is isoprene.

4.2.72.2.13 isopropylamine: the gaseous cargo is isopropylamine.

4.2.72.2.14 methane: the gaseous cargo is methane.

4.2.72.2.15 methyl chloride: the gaseous cargo is methyl_chloride.

4.2.72.2.16 monoethylamine: the gaseous cargo is monoethylamine.

4.2.72.2.17 naptha: the gaseous cargo is naptha.

4.2.72.2.18 propane: the gaseous cargo is propane.

4.2.72.2.19 propane butane mix: the gaseous cargo is propane_butane_mix.

4.2.72.2.20 propylene oxide: the gaseous cargo is propylene_oxide.

4.2.72.2.21 propylene: the gaseous cargo is propylene.

4.2.72.2.22 vinyl ethyl ether: the gaseous cargo is vinyl_ethyl_ether.

4.2.72.2.23 vinyl chloride monomer: the gaseous cargo is vinyl_chloride_monomer.

4.2.73 General_characteristics_definition

The General_characteristics_definition provides a major part of the documentation of the vessel. It includes primary dimensions and capacities due to the contract of the ship.

The data associated with a General_characteristics_definition are the following:

— defined_for.

The defined_for specifies a Ship or set of Ships for which the General_characteristics_definition applies.

4.2.74 General_compartment_property_set

A General_compartment_property_set is a collection generic properties that are applicable to all types of compartments. A set of such properties is referenced by the Compartment_design_definition through the properties attribute.

The data associated with a General_compartment_property_set are the following:

- areas;
- corrosion_protection;
- naval_administrative_properties;
- permeability;
- required_bulkhead_tightness;
- volume.

4.2.74.1 areas

The areas specifies a collection of cross sectional and surface area properties for a Compartment.

4.2.74.2 corrosion_protection

The corrosion_protection specifies the treatments used for protecting compartment internals and boundaries from corrosion.

4.2.74.3 naval_administrative_properties

The naval_administrative_properties specifies a set of properties used specifically in the design and construction of naval vessels. These properties normally do not apply to the design and construction of commercial vessels. The naval_administrative_properties need not be specified for a particular General_compartment_property_set.

4.2.74.4 permeability

The permeability specifies a collection of key parameters for the stability calculations of a ship.

4.2.74.5 required_bulkhead_tightness

The required_bulkhead_tightness specifies the required ability to prevent the passage of air or liquid for all bulkheads forming the boundary of the compartment.

The value of the required_bulkhead_tightness shall be one of the following:

- air tight;
- fume tight;
- watertight;
- oil tight;
- non tight;
- expanded metal;
- user defined.

NOTE - See 4.2.73.5.1 - 4.2.73.5.7 for the definition of each allowable value for required_bulkhead_tightness.

4.2.74.5.1 air tight: the compartment boundaries shall be designed to prevent the passage of air.

4.2.74.5.2 fume tight: the compartment boundaries shall be designed to prevent the passage of fumes.

4.2.74.5.3 water tight: the compartment boundaries shall be designed to prevent the passage of water.

4.2.74.5.4 oil tight: the compartment boundaries shall be designed to prevent the passage of oil.

4.2.74.5.5 non tight: the compartment boundaries shall not be closed to prevent the passage of air, oil, water, or fumes.

4.2.74.5.6 expanded metal: the compartment boundaries may consist of expanded metal mesh and therefore will not be closed to prevent the passage of air, oil, water, or fumes.

4.2.74.5.7 user defined: the compartment boundary tightness is defined by the user_def_function attribute.

4.2.74.6 volume

The volume specifies a collection of volume properties for a compartment.

4.2.75 Geometrically_bounded_wireframe

A Geometrically_bounded_wireframe is a type of Moulded_form_representation (see) that is based on 3D curves and that has a no associated topological information.

4.2.76 Global_axis_placement

A Global_axis_placement is a type of General_characteristics_definition (see) that defines a fixed system of right handed orthogonal axes to which geometric data are referred. A Global_axis_placement shall have a positive vertical axis that lies in the direction from the base of the ship upwards and an x-axis that lies along the baseline with the positive direction that is in either direction along the baseline, but fixed for any particular ship. The origin of the Global_axis_placement shall lie along the x-axis. The distance of the after perpendicular from the origin shall be specified If any other system of axes is used, local or global, then the transformation relations between it and the Global_axis_placement shall be specified.

The data associated with a Global_axis_placement are the following:

— after_perpendicular_offset;

— orientation.

4.2.76.1 after_perpendicular_offset

The after_perpendicular_offset specifies the distance from the origin to the after perpendicular.

4.2.76.2 orientation

The orientation specifies the direction of the x-axis. The value of orientation shall be one of the following:

— aft pointing;

— forward pointing.

NOTE - See ? - ? for the definition of each allowable value for orientation.

4.2.76.2.1 aft pointing: the global axis is at the forward end of the ship with increasing x values towards the aft end.

4.2.76.2.2 forward pointing: the global axis is at the aft end of the ship with increasing x values towards the forward end.

4.2.77 Gross_tonnage

Gross_tonnage is a type of Tonnage (see). It is the result of a calculation representing the total volume of a ship. It is the sum of the overdeck and underdeck tonnages.

The data associated with a Gross_tonnage are the following:

— overdeck_tonnage;

— underdeck_tonnage.

4.2.77.1 overdeck_tonnage

The overdeck_tonnage specifies the volume to the inside of the frames and deck plating of the between decks, poop, bridge, forecastle, deckhouses and erections above the tonnage deck less the exempted spaces. Spaces exempted include dry cargo space (unless in a break in the deck) and certain closed-in spaces associated with machinery, safety equipment, navigation, galleys, washrooms, water ballast and workshops.

4.2.77.2 underdeck_tonnage

The underdeck_tonnage specifies the total volume of the ship below the tonnage deck to the inside of the frames, underside of the deck plating and above the inner bottom.

4.2.78 Habitable_compartment_design_definition

A Habitable_compartment_design_definition is a type of Compartment_design_definition (see) which provides the abstract definition of a version of a Habitable_compartment from a design perspective. The Habitable_compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Habitable_compartment.

The data associated with a Habitable_compartment_design_definition are the following:

— habitable_compartment_properties.

The habitable_compartment_properties specifies the reference to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Habitable_compartment.

4.2.79 Habitable_compartment_functional_definition

The Habitable_compartment_functional_definition is the functional role of a Habitable_compartment. The role may be a pre-defined one or may be user-defined.

The data associated with a Habitable_compartment_functional_definition are the following:

— used_for.

The used_for specifies the name of a function that a specific Habitable_compartment may have in a ship. The value of the used_for shall be one of the following:

— berthing;

— cabin;

— control;

— passageway;

— medical;

— lounge;

— access trunk;

— user defined.

NOTE - See 4.2.77.1 - 4.2.77.8 for the definition of each allowable value for used_for.

4.2.79.1 berthing: the Habitable_compartment is designed to be used as berthing space.

4.2.79.2 cabin: the Habitable_compartment is designed to be used as cabin space.

4.2.79.3 control: the Habitable_compartment is designed to be used for ship command and control functions.

4.2.79.4 passageway: the Habitable_compartment is designed to be used as a passageway.

4.2.79.5 medical: the Habitable_compartment is designed to be used as a medical space.

4.2.79.6 lounge: the Habitable_compartment is designed to be used as a lounge space.

4.2.79.7 access trunk: the Habitable_compartment is designed to be used as an access trunk.

4.2.79.8 user defined: the use of the Habitable_compartment is defined by the user_def_function attribute.

4.2.80 Habitable_compartment_property_set

The Habitable_compartment_property_set is a collection of properties specific to compartments designed for human habitation.

The data associated with a Habitable_compartment_property_set are the following:

— air_circulation_rate;

— illumination_value;

— max_occupancy.

4.2.80.1 air_circulation_rate

The air_circulation_rate specifies the measure of the volume of air changes for the compartment per unit of time.

NOTE - This information is used by applications performing HVAC load analyses. There are other attributes required to support HVAC activities and they will be defined in a future STEP HVAC AP.

4.2.80.2 illumination_value

The illumination_value specifies the amount of lighting required for a compartment.

NOTE - This information is used by electrical applications performing lighting analyses.

4.2.80.3 max_occupancy

The max_occupancy specifies the maximum number of humans which are allowed to occupy a Habitable_compartment. The max_occupancy need not be specified for a particular Habitable_compartment_property_set.

4.2.81 Habitable_compartment

A Habitable_compartment is a Compartment (see), which is primarily designated as suitable for occupancy by humans. Passenger safety and comfort are subject to international, national, Class Society, or other regulations usually covered by product specifications and applicable class and register notations.

The data associated with a Habitable_compartment are the following:

— roles.

The roles specifies that the intended functions of a Habitable_compartment shall be of the type given by the Habitable_compartment_functional_definition.

4.2.82 Item_relationship

An Item_relationship defines the association of two Items that are in some manner dependent upon each other.

The data associated with an Item_relationship are the following:

— contxt;

— item_1;

— item_2.

4.2.82.1 contxt

The contxt specifies the what is significant about the Items in their relationship to each other in order to identify the impact of changes to an Item on the related Item.

4.2.82.2 item_1

The item_1 specifies the relating item in the relationship.

4.2.82.3 item_2

The item_2 specifies the related item in the relationship.

4.2.83 Item

An Item is a discrete, identifiable thing used in one or more design or production activities. An Item is a thing created by a physical or mental activity, or derived from one or more other Items. An Item need not represent a physically realisable thing. It may also represent some abstract concept such as an activity or task. An Item may have relationships to other Items, or be member in an Item_structure.
The data associated with an Item are the following:

— description;

— documentation;

— id;

— ship_context.

4.2.83.1 description

The description specifies a textual description for an item.

4.2.83.2 documentation

The documentation specifies the printed information available pertaining to an Item. A documentation need not be specified for a particular Item.

4.2.83.3 id

The id specifies a text string for item identification.

4.2.83.4 ship_context

The ship_context specifies the intended purpose of this item in terms of its applicability to a ship. A ship_context need not be specified for a particular Item.

4.2.84 Item_structure

An Item_structure is a collection of Items related by Item_relationships. An Item_structure forms a graph without any restriction regarding the number of members, the connectivity, or the cyclicity of the graph.
The data associated with an Item_structure are the following:

— item_relationships;

— items.

4.2.84.1 item_relationships

The item_relationships specifies the relationships between the Items.

4.2.84.2 items

The items specifies the Items belonging to the collection.

4.2.85 Lane_position

A Lane_position is the positon of a Unit cargo using a definition of the lanes on a deck.
NOTE - Lane_position will usually apply to vehicles loaded onto, for example, a roll-on roll-off ferry.
The data associated with a Lane_position are the following:

— deck_number;

— frame_number;

— lane_number;

— relating_to.

4.2.85.1 deck_number

The deck_number specifies the deck onto which the cargo has been loaded.

4.2.85.2 frame_number

The frame_number specifies the longitudinal position of the cargo on the deck.

4.2.85.3 lane_number

The lane_number specifies the transverse position of the unit cargo on the deck.

4.2.85.4 relating_to

The relating_to specifies the definition of the lanes to which the position refers.

4.2.86 Liquid_cargo_assignment

A liquid_cargo_assignment is a type of Compartment_cargo_assignment (see). It is a consignment of Liquid_cargo or Gaseous_cargo that has been allocated and loaded into a ship tank.

4.2.87 Liquid_cargo

A Liquid_cargo is a type of Ship_cargo (see). It is any cargo whose natural condition is a non-solid, non-gaseous liquid state.

The data associated with a Liquid_cargo are the following:

— required_carriage_pressure;

— type_of.

4.2.87.1 required_carriage_pressure

The required_carriage_pressure specifies the required pressure of the compartment in which the cargo is to be carried.

4.2.87.2 type_of

The type_of specifies the type of the liquid cargo.

The value of the type_of shall be one of the following:

— aviation oil;

— cement;

— chemical;

— crude oil;

— edible oil;

— fuel oil;

— fresh water;

— liquified petroleum gas;

— lubricating oil;

— product oil;

— salt water;

— sullage;

— vegetable oil;

— water ballast.

NOTE - See 4.2.85.2.1 - 4.2.85.2.14 for the definition of each allowable value for type_of.

4.2.87.2.1 aviation oil: the liquid cargo is aviation_oil.

4.2.87.2.2 cement: the liquid cargo is cement.

4.2.87.2.3 chemical: the liquid cargo is chemical.

4.2.87.2.4 crude oil: the liquid cargo is crude_oil.

4.2.87.2.5 edible oil: the liquid cargo is edible_oil.

4.2.87.2.6 fuel oil: the liquid cargo is fuel_oil.

4.2.87.2.7 fresh water: the liquid cargo is fresh_water.

4.2.87.2.8 liquified petroleum gas: the liquid cargo is liquified_petroleum_gas.

4.2.87.2.9 lubricating oil: the liquid cargo is lubricating_oil.

4.2.87.2.10 product oil: the liquid cargo is product_oil.

4.2.87.2.11 salt water: the liquid cargo is salt_water.

4.2.87.2.12 sullage: the liquid cargo is sullage.

4.2.87.2.13 vegetable oil: the liquid cargo is vegetable_oil.

4.2.87.2.14 water ballast: the liquid cargo is water_ballast.

4.2.88 Loading_condition_definition

A loading_condition is a type of Definition (see). It is the description of the loading of the ship, including cargo loads which have been allocated and loaded into compartments or on decks, the associated deadweight and floating position.

The data associated with a Loading_condition_definition are the following:

— cargo_loads;

— deadweight;

— description;

— floating_position.

4.2.88.1 cargo_loads

The cargo_loads specifies the description of the cargo items which have been loaded onto the ship.

4.2.88.2 deadweight

The deadweight specifies the definition of the non-cargo deadweight value and its derivation.

4.2.88.3 description

The description specifies a free text description of the loading condition. A description need not be specified for a particular Loading_condition_definition.

4.2.88.4 floating_position

The floating_position specifies the attitude of the ship in the water for the particular loading condition.

4.2.89 Loading_condition_design_definition

A loading_condition_design_definition is a type of Loading_condition_definition (see). It is the desription of the loading of the ship, including cargo loads which have been allocated and loaded onto a ship, the associated deadweight and floating position necessary for analysis.

The data associated with a Loading_condition_design_definition are the following:

— type_of.

The type_of specifies the type of design loading condition.

The value of the type_of shall be one of the following:

— maximum;

— minimum;

— actual;

— expected.

NOTE - See 4.2.87.1 - 4.2.87.4 for the definition of each allowable value for type_of.

4.2.89.1 maximum: the maximum design loading condition.

4.2.89.2 minimum: the minimum design loading condition.

4.2.89.3 actual: the normal design loading condition.

4.2.89.4 expected: the loading condition used to perform 'what-if' analyses.

4.2.90 Loading_condition_operating_definition

A Loading_condition_operating_definition is a type of Loading_condition_definition (see). It is the description of the loading of the ship, including cargo loads which have been allocated and loaded onto a ship, the associated deadweight, and the place and date of loading.

The data associated with a Loading_condition_operating_definition are the following:

— date_of_loading;

— place_of_loading;

— type_of.

4.2.90.1 date_of_loading

The date_of_loading specifies the date and time when the ship was loaded to its present condition. A date_of_loading need not be specified for a particular Loading_condition_operating_definition.

4.2.90.2 place_of_loading

The place_of_loading specifies the port at which the ship was last loaded. A place_of_loading need not be specified for a particular Loading_condition_operating_definition.

4.2.90.3 type_of

The type_of specifies the type of operating loading condition.

The value of the type_of shall be one of the following:

— arrival;

— departure;

— actual;

— other.

NOTE - See 4.2.88.3.1 - 4.2.88.3.4 for the definition of each allowable value for type_of.

4.2.90.3.1 arrival: the loading condition when the ship docked at port.

4.2.90.3.2 departure: the loading condition when the ship embarked from port.

4.2.90.3.3 actual: the loading condition when the ship is in normal service.

4.2.90.3.4 other: some other loading condition than arrival, departure, or actual.

4.2.91 Local_co_ordinate_system

A Local_co_ordinate_system is used to locate something in space. A Local_co_ordinate_system is always defined with respect to another Co_ordinate_system: this might be the Global_co_ordinate_system or another Local_co_ordinate_system which has to member in the same hierarchy.

NOTE 1 - The local axes directions are called u, v, and w. The local w-direction is normal to the plane, defined by local_u and local_v.

NOTE 2 - A local co-ordinate system shall form a right handed system.

The data associated with a Local_co_ordinate_system are the following:

— local_u;

— local_v;

— local_w;

— parent;

— u;

— v;

— w.

4.2.91.1 local_u

The local_u specifies the local axis, defined in the underlying global or local coordinate system.

4.2.91.2 local_v
The local_v specifies the local axis perpendicular to local_u, defined in the underlying global or local coordinate system.

4.2.91.3 local_w
The local_w specifies the local w axis perpendicular to local_u and local_w, defined in the underlying global or local coordinate system.

4.2.91.4 parent
The parent specifies the underlying coordinate system which serves as definition space for a particular Local_co_ordinate_system.

4.2.91.5 u
The u specifies the coordinate for the origin, value along parent u-axis.

4.2.91.6 v
The v specifies the coordinate for the origin, value along parent w-axis.

4.2.91.7 w
The w specifies the coordinate for the origin, value along parent w-axis.

4.2.92 Longitudinal_position
A Longitudinal_position is a type of Spacing_position (see) that specifies a location on the x-axis of the ship coordinate system . A Longitudinal_position may be defined by an offset distance from a given Spacing_position.

The data associated with a Longitudinal_position are the following:

— offset.

The offset specifies the distance from the location specified in Spacing_position. An offset need not be specified for a particular Longitudinal_position.

4.2.93 Machinery_compartment_design_definition
A Machinery_compartment_design_definition is a type of Compartment_design_definition (see) which provides the abstract definition of a version of a Machinery_compartment from a design perspective. The Machinery_compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Machinery_compartment.

The data associated with a Machinery_compartment_design_definition are the following:

— machinery_compartment_properties.

The machinery_compartment_properties specifies the reference to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Machinery_compartment.

4.2.94 Machinery_compartment_functional_definition
The Machinery_compartment_functional_definition is the functional purpose of a Machinery_compartment. The role may be a pre-defined one or may be user-defined.

The data associated with a Machinery_compartment_functional_definition are the following:

— used_for.

The used_for specifies the name of a function that a specific Machinery_compartment may have in a ship. The value of the used_for shall be one of the following:

— main engine room;

— auxiliary engine room;

— bow thruster room;

— equipment room;

— user defined.

NOTE - See 4.2.92.1 - 4.2.92.5 for the definition of each allowable value for used_for.

4.2.94.1 main engine room: the Machinery_compartment is designed to be used as the main engine room.

4.2.94.2 auxiliary engine room: the Machinery_compartment is designed to be used

as an auxiliary engine room space.

4.2.94.3 bow thruster room: the Machinery_compartment is designed to be used as the bow thruster room.

4.2.94.4 equipment room: the Machinery_compartment is designed to be used as an equipment_room.

4.2.94.5 user defined: the use of the Machinery_compartment is defined by the user_def_function attribute.

4.2.95 Machinery_compartment

A Machinery_compartment is a compartment which is designated primarily for the installation of any kind of machinery or equipment.

EXAMPLE 8 - Engine room and bow thruster room are types of Machinery compartments.

The data associated with a Machinery_compartment are the following:

— roles.

The roles specifies that the intended use of a Machinery_compartment shall be as specified by a Machinery_compartment_functional_definition.

4.2.96 Manufacturing_definition

The Manufacturing_definition is a manufacturing life-cycle specific view for specification of appropriate attributes and properties of an Item.

The data associated with a Manufacturing_definition are the following:

— representations.

The representations specifies the the geometric or non-geometric representations of the manufacturing definition of an Item. It is possible for a Manufacturing _definition to have multiple representations.

4.2.97 Moulded_form_representation

A Moulded_form_representation is a type of Representation (see) that is the means of defining the shape of the Moulded_form using geometry constructs and measures. A Moulded_form_representation is either a Geometrically_bounded_wireframe (see), a Non_manifold_surface_representation (see), or an Offset_table_representation (see) A Moulded_form_representation is abstract in concept and does not detail the geometry but only provides references to the geometry and any global constraints that it may possess. The geometric constructs in a Moulded_form_representation may reference a Ship_point (see), a Ship_curve (see) or a Ship_surface (see).

The data associated with a Moulded_form_representation are the following:

— items;

— moulded_form_representation_id;

— symmetry.

4.2.97.1 items

The items specifies the collection of geometrical and topological elements (Representation_items) in the representation.

4.2.97.2 moulded_form_representation_id

The moulded_form_representation_id specifies the context specific label for the Moulded_form_representation. The name need not be specified for a particular Moulded_form_representation.

4.2.97.3 symmetry

The symmetry specifies that the Moulded_form_representation is symmetrical. The symmetry details the area of the ship that when either mirrored or rotated will generate the symmetrical Moulded_form_representation. The symmetry need not be specified for a particular Moulded_form_representation.

4.2.98 Moulded_form_representation_relationship

A Moulded_form_representation_relationship is a type of Representation_relationship (see)and describes relationship between two Moulded_form_representations.

The data associated with a Moulded_form_representation_ relationship are the following:

— rep_1;
— rep_2;
— id.

4.2.98.1 rep_1

The rep_1 specifies the Moulded_form_representation that forms the basis of the Moulded_form_representation_relationship.

4.2.98.2 rep_2

The rep_2 specifies the Moulded_form_representation that is to be associated with rep_1.

4.2.98.3 id

The id specifies a context specific identifier for the Moulded_form_representation_relationship.

4.2.99 Moulded_form_representation_symmetry

A Moulded_form_representation_symmetry is an area of the ship that when either mirrored or rotated will generate a symmetrical Moulded_form_representation.

The data associated with a Moulded_form_representation_ relationship are the following:

— ship_area_covered;
— axis_of_symmetry.

4.2.99.1 ship_area_covered

The ship_area_covered specifies the name of the region of the ship that when mirrored or rotated forms a symmetrical representation of the type specified in axis_of_symmetry.

The value of the ship_area_covered shall be one of the following:

— port_forward_quarter;
— port_aft_quarter;
— starboard_aft_quarter;
— starboard_forward_quarter;
— starboard_half;
— port_half.

NOTE - See 4.2.97.1.1 - 4.2.97.1.6 for the definition of each allowable value for ship_area_covered.

4.2.99.1.1 port_forward_quarter: the area of the ship lying port side of the centreplane and forward side of amidships that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.1.2 port_aft_quarter: the area of the ship lying port side of the centreplane and after side of amidships that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.1.3 starboard_aft_quarter: the area of the ship lying starboard side of the centreplane and after side of amidships that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.1.4 starboard_forward_quarter: the area of the ship lying starboard side of the centreplane and forward side of amidships that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.1.5 starboard_half: the area of the ship lying starboard side of the centreplane that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.1.6 port_half: the area of the ship lying port side of the centreplane that is rotated or mirrored about the centreline or centreplane respectively.

4.2.99.2 axis_of_symmetry

The axis_of_symmetry specifies a type of symmetry used in the representation.

The value of the axis_of_symmetry shall be one of the following:

— mirrored_symmetry;

— rotational_symmetry.

NOTE - See 4.2.97.2.1 - 4.2.97.2.2 for the definition of each allowable value for ship_area_covered.

4.2.99.2.1 mirrored_symmetry: symmetry about a plane.

4.2.99.2.2 rotational_symmetry: symmetry due to rotation about a point or line.

4.2.100 Moment_3d

A Moment_3d is a collection of moment components on the three major co-ordinate system axes, vertical, transverse and longitudinal.

The data associated with a Moment_3d are the following:

— longitudinal_moment;

— origins;

— transverse_moment;

— vertical_moment.

4.2.100.1 longitudinal_moment

The longitudinal_moment specifies the moment component about the longitudinal axis.

4.2.100.2 origins

The origins specifies the point in the local co-ordinate system about which the moment component's lever arms were computed.

4.2.100.3 transverse_moment

The transverse_moment specifies the moment component about the transverse axis.

4.2.100.4 vertical_moment

The vertical_moment specifies the moment component about the vertical axis.

4.2.101 Moments_of_inertia

Add Definition

The data associated with a Moments_of_inertia are the following:

— long_moment_of_inertia;

— trans_moment_of_inertia;

— vert_moment_of_inertia.

4.2.101.1 long_moment_of_inertia

The long_moment_of_inertia specifies the value of the second moment of the boundary formed by the intersection of the compartment and a plane representing the cargo interface (i.e., the liquid cargo static waterline). The lever of the moment is parallel to the longitudinal axis of the ship.

4.2.101.2 trans_moment_of_inertia

The trans_moment_of_inertia specifies the value of the second moment of the boundary formed by the intersection of the compartment and a plane representing the cargo interface (i.e., the liquid cargo static waterline). The lever of the moment is parallel to the transverse axis of the ship.

4.2.101.3 vert_moment_of_inertia

The vert_moment_of_inertia specifies the value of the second moment of the boundary formed by the intersection of the compartment and a plane representing the cargo interface (i.e., the liquid cargo static waterline). The lever of the moment is parallel to the vertical axis of the ship.

4.2.102 Moulded_form_design_definition

A Moulded_form_design_definition is a type of Design_definition (see) that details the moulded form information for a structural surface.

The data associated with a Moulded_form_design_definition are the following:

— usage.

The usage specifies the area of the ship to which the Moulded_form_design_definition applies and thus the purpose the Moulded_form has in relation to the ship.

The value of the usage shall be one of the following:

— blending surface;

— bottom;
— deck;
— horizontal girder;
— hull appendage;
— hull inlet;
— hullmoulded form;
— hull surface;
— inner bottom;
— innerhull;
— longitudinal bulkhead;
— longitudinal girder;
— transverse bulkhead;
— transverse frame;
— user defined.

NOTE - See 4.2.97.1.1 - 4.2.97.1.15 for the definition of each allowable value for usage.

4.2.102.1.1 blending surface: a surface that forms a transition between a hull exterior and a hull inlet or hull appendage.

4.2.102.1.2 bottom: the lowest part of the hull moulded form, as measured in the global coordinate system.

4.2.102.1.3 deck: a discrete horizontal, or near horizontal, bounded surface through the ship.

4.2.102.1.4 horizontal girder: a longitudinal ship primary structural element that lies in the horizontal plane.

4.2.102.1.5 hull appendage: a protrusion from the hull moulded form important to the design of the ship.

4.2.102.1.6 hull inlet: a depression or passage in the hull moulded form important to the design of the ship.

4.2.102.1.7 hull moulded form: the shape and dimension of a ship hull that does not include information on the thickness of the material from which the hull is constructed.

4.2.102.1.8 hull surface: a bounded surface that is part of the hull_moulded_form.

4.2.102.1.9 inner bottom: the lowermost deck in the ship that forms the internal bottom for double hull ships.

4.2.102.1.10 inner hull: the surface that forms internal hull moulded form for double hull ships.

4.2.102.1.11 longitudinal bulkhead: a vertical, or near vertical, structural element arranged longitudinally in the ship that forms a compartment boundary and contributes significantly to the ship's sub-division and strength.

4.2.102.1.12 longitudinal girder: a continuous longitudinal primary structural element that lies in the vertical plane.

4.2.102.1.13 transverse bulkhead: a vertical, or near vertical, primary structural element arranged transversely in the ship that forms a compartment boundary and contributes significantly to the ship's sub-division and strength.

4.2.102.1.14 transverse frame: a vertical, or near vertical, structural element arranged transversely in the ship that contributes significantly to the ship's strength.

4.2.102.1.15 user defined: a region on the ship moulded form whose function is

unknown or not recorded.

4.2.103 Moulded_form_relationship

A Moulded_form_relationship is a type of Item_relationship (see) and describes a relationship between two Moulded_forms. A collection of Moulded_form_relationships may describe a hierarchy of inter-related Moulded_forms that together provide a description of the ship.

The data associated with a Moulded_form_relationship are the following:

— item_1;

— item_2.

4.2.103.1 item_1

The item_1 specifies the Moulded_form that forms the basis of the Moulded_form_relationship

4.2.103.2 item_2

The item_2 specifies the Moulded_form that is to be associated with item_1

4.2.104 Moulded_form

A Moulded_form is a type of Item (see) that defines the shape and set of dimensions of a ship, or any part of it. A Moulded_form does not include information on the thickness of the material from which it is constructed.

4.2.105 Net_tonnage

The Net_tonnage is a type of Tonnage (see). It is a calculation of the cargo carrying space within the ship. It is the Gross_tonnage with deductions for crew spaces, engine room, water ballast and any space not used for passengers or cargo.

4.2.105.1 Non_manifold_surface_representation

A Non_manifold_surface_representation is a type of Moulded_form_representation (see) that is based on surfaces and that has a topology suitable for describing inter-connected surfaces patches.

4.2.106 Part_relationship

A Part_relationship defines the association of two Parts. The related items are restricted to be of type Part.

The data associated with a Part_relationship are the following:

— item_1;

— item_2.

4.2.106.1 item_1

The item_1 specifies the relating Part.

4.2.106.2 item_2

The item_2 specifies The related Part.

4.2.107 Part

A Part is an item created by a physical activity and made of a material. It is the atomic element within a system, assembly or product structure. The Item structure functionality in the definition of a Compartment references all of the Parts of various types contained within the compartment boundaries to create the compartment’s product structure.

4.2.108 Person_group

A Person_group is the number, position on the ship, and the weight of a number of passengers or crew.

The data associated with a Person_group are the following:

— number_of_people;

— person_type.

4.2.108.1 number_of_people

The number_of_people specifies the number of people in the group.

4.2.108.2 person_type

The person_type specifies the type of people in the group.

The value of the person_type shall be one of the following:

— passengers;

— crew;
— officers;
— enlisted.

NOTE - See 4.2.103.2.1 - 4.2.103.2.4 for the definition of each allowable value for person_type.

4.2.108.2.1 passengers: the people in the group are passengers.

4.2.108.2.2 crew: the people in the group are crew.

4.2.108.2.3 officers: the people in the group are officers.

4.2.108.2.4 enlisted: the people in the group are enlisted personnel.

4.2.109 Primer_coating

A primer_coating is a coating used to coat steel after surface preparation and prior to fabrication, such that it has no significant deleterious effect on subsequent welding work.

4.2.110 Ship

A Ship is the primary naval architectural product. All data defining the product, in any life cycle stage, is related to the Ship. A project, which represents a ship in the early design phase, for example before contract, is also regarded as a ship.

The data associated with a Ship are the following:

— id;
— units.

4.2.110.1 id

The id specifies the name that the originator of the idea for a certain ship has given to that instance.

NOTE - The name of the ship is specified as a Definition in Ship_designation, where it may be versioned.

4.2.110.2 units

The units specifies the reference to a set of pre-defined global units for all types of measures that may appear in the ship product model.

4.2.111 Ship_cargo

A Ship_cargo is any item of a temporary nature loaded onboard a ship for the purpose of being consumed during the voyage, used by the crew or passengers, transferred to another ship while underway, or offloaded at one of the destination ports. Ship_cargo may be secured from shifting during the voyage, but is not permanently afixed to the ship. A Ship_cargo may be either a Liquid_cargo (see), a Gaseous_cargo (see) or a Dry_cargo (see).

The data associated with a Ship_cargo are the following:

— material_properties;
— cargo_hazard;
— description;
— flash_point;
— pollution_code;
— references;
— required_carriage_temperature.

4.2.111.1 material_properties

The material_properties specifies the physical properties of the material which makes up the ship cargo. A material_properties need not be specified for a particular Ship_cargo.

4.2.111.2 cargo_hazard

The cargo_hazard specifies the classification of the hazards associated with the cargo. A cargo_hazard need not be specified for a particular Ship_cargo.

4.2.111.3 description

The description specifies the free text description of the cargo.

4.2.111.4 flash_point

The flash_point specifies the temperature at which the cargo will spontaneously combust.

4.2.111.5 pollution_code

The pollution_code specifies the pollution potential of the cargo if released into the water, according to MARPOL 73-78, Annex II.

The value of the pollution_code shall be one of the following:

— code A;
— code B;
— code C;
— code D.

NOTE - See 4.2.105.5.1 - 4.2.105.5.4 for the definition of each allowable value for pollution_code.

4.2.111.5.1 code A: the cargo cannot be released into the sea.

4.2.111.5.2 code B: 0.1 cubic metres/tank of the cargo can be released into the sea.

4.2.111.5.3 code C: 0.3 cubic metres/tank of the cargo can be released into the sea.

4.2.111.5.4 code D: the cargo can be released into the sea so long as it is diluted.

4.2.111.6 references

The references specifies the documentation which may be of relevance to the carriage of the cargo. These may be material data sheets, technical specifications, or additional safety information.

4.2.111.7 required_carriage_temperature

The required_carriage_temperature specifies the required temparature of the cargo while stowed.

4.2.112 Ship_curve

A Ship_curve is a type of Curve (see 4.2.48) that is commonly used in naval architecture and that has an associated name.

EXAMPLE 9 - a waterline that has a geometry defined by a B-spline curve.

The data associated with a Ship_curve are the following:

— curve_class;
— curve_shape.

4.2.112.1 curve_class

The curve_class specifies the naval architecture category for the Ship_curve. The categorisation uses curves that are commonly required for the design definition of the hull moulded form

The value of curve_class shall be one of the following:

— buttock line;
— centreline profile;
— deck line;
— flat of bottom;
— flat of side;
— intersection line;
— knuckle line;
— tangent line;
— transverse section;
— unspecified;
— waterline.

NOTE - See 4.2.112.1.1 - 4.2.112.1.11 for the definition of each allowable value for curve_class.

4.2.112.1.1 buttock line: a curve that is the intersection of a longitudinal plane with a hull moulded form.

4.2.112.1.2 centreline profile: a curve that is the intersection of the centreplane with the hull moulded form.

4.2.112.1.3 deck line: a curve lying on the moulded surface of a deck.

4.2.112.1.4 flat of bottom: the boundary of the planar surface at the base of a ship.

4.2.112.1.5 flat of side: the boundary of the planar surface at the outer-most port or starboard side of a ship.

4.2.112.1.6 intersection line: a curve that is the intersection of two surfaces found on or within a ship moulded form.

4.2.112.1.7 knuckle line: a continuous boundary between two moulded form surfaces that has discontinuity in tangency across it. A knuckle line may pass through a number of knuckle points.

4.2.112.1.8 tangent line: a continuous boundary between two moulded form surfaces that has a specified tangent across it. A tangent line may pass through a number of tangent points.

4.2.112.1.9 transverse section: a curve that is the intersection of a transverse plane with a ship moulded form.

4.2.112.1.10 unspecified: a line whose relation to naval architecture is not known or not recorded.

4.2.112.1.11 waterline: a curve that is the intersection of the waterplane with a ship moulded form.

4.2.112.2 curve_shape

The curve_shape specifies the underlying geometric definition of the Ship_curve

4.2.113 Ship_surface

A Ship_surface is a type of Surface (see) in commonly used in naval architecture that has an associated name.

The data associated with a Ship_surface are the following:

— surface_class;

— surface_shape.

4.2.113.1 surface_class

The surface_class specifies the naval architecture category for the Ship_surface. The categorisation is based on the distinction between a surface that is external, and on the hull moulded form, and a surface that is internal, and on a structural element.

The value of the surface_class shall be one of the following:

— external surface;

— internal surface.

NOTE - See 4.2.113.1.1 - 4.2.113.1.2 for the definition of each allowable value for surface_class.

4.2.113.1.1 external surface: a surface that is, or forms part of, the hull moulded form.

4.2.113.1.2 internal surface: a surface that is, or forms part of, a structural element other than the hull moulded form, hull inlet or hull appendage.

4.2.113.2 surface_shape

The surface_shape specifies the underlying geometric definition of the Ship_surface.

4.2.114 Space_adjacency_relationship

A Space_adjacency_relationship is a type of Space_relationship (see) that identifies spaces that share a common boundary. These spaces may be arranged relative to one another and the relationship may exhibit

certain properties or characteristics. A collection of adjacency relationships define an arrangement and are valid only in the context of a specific space.
The data associated with a Space_adjacency_relationship are the following:

— adjacency_access;
— adjacency_orientation;
— adjacency_type;
— adjacent_space_surface_area.

4.2.114.1 adjacency_access

The adjacency_access specifies the indicator used to denote the fact that it is intended that a means be provided to allow passage of a person between the two adjacent spaces. This specifies the design intent of accessibility.

4.2.114.2 adjacency_orientation

The adjacency_orientation specifies the positional context between two adjacent spaces.
The value of the adjacency_orientation shall be one of the following:

— above;
— below;
— port;
— starboard;
— forward;
— aft.

NOTE - See 4.2.107.2.1 - 4.2.107.2.6 for the definition of each allowable value for adjacency_orientation.

4.2.114.2.1 above: the related Space (Item_2) is above the relating Space (Item_1).

4.2.114.2.2 below: the related Space (Item_2) is below the relating Space (Item_1).

4.2.114.2.3 port: the related Space (Item_2) is port of the relating Space (Item_1).

4.2.114.2.4 starboard: the related Space (Item_2) is starboard of the relating Space (Item_1).

4.2.114.2.5 forward: the related Space (Item_2) is forward of the relating Space (Item_1).

4.2.114.2.6 aft: the related Space (Item_2) is aft of the relating Space (Item_1).

4.2.114.3 adjacency_type

The adjacency_type specifies whether the two adjacent spaces are completely or partially adjacent.
The value of the adjacency_type shall be one of the following:

— partial;
— complete.

NOTE - See 4.2.107.3.1 - 4.2.107.3.2 for the definition of each allowable value for adjacency_type.

4.2.114.3.1 partial: the two spaces do not have identical boundaries with respect to a specific orientation.

4.2.114.3.2 complete: the two spaces have identical boundaries with respect to a specific orientation. (e.g., both share a common forward longitudinal extent, or a common port transverse extent).

4.2.114.4 adjacent_space_surface_area

The adjacent_space_surface_area specifies the area of that portion of the boundary between adjacent spaces that is common to both spaces.

4.2.115 Space_connection_relationship

A Space_connection_relationship is a type of Space_relationship (see) that identifies spaces which are intended to be interconnected in some way.

EXAMPLE 10 - Two tanks may be interconnected by a piping system to allow transfer of ballast water

bewteen tanks.

The data associated with a Space_connection_relationship are the following:

— connecting_system.

The connecting_system specifies the identification of the system that connects the two Spaces.

4.2.116 Space_enclosing_relationship

A Space_ enclosing _relationship is a type of Space_relationship (see) that identifies spaces that are wholly contained within other spaces. An enclosed space is one that does not share a common boundary with another space, such as a lube oil storage tank mounted on a foundation within the main engine room.

4.2.117 Space_functional_relationship

A Space_ functional _relationship is a type of Space_relationship (see) that identifies spaces that are associated with other spaces because of some common functionality.

EXAMPLE 11 - Some examples of this type of relationship are port and starboard pairs of anti-roll tanks, or an ammunition storage space, a cargo/weapons elevator, and a gun turret.

4.2.118 Space_positional_relationship

A Space_positional_relationship is a type of Space_relationship (see) that identifies a space whose position is dependent upon another space. A variety of positional relationship types are supported that serve to define the significant aspects of the relationship.

The data associated with a Space_positional_relationship are the following:

— relationship_type.

The relationship_type specifies the kind of space positional relationship expressed. These types are defined in terms of topological aspects of the related space.

The value of the relationship_type shall be one of the following:

— forward longitudinal extent;
— aft longitudinal extent;
— port transverse extent;
— starboard transverse extent;
— forward starboard corner;
— forward port corner;
— aft starboard corner;
— aft port corner;
— centeredtransverse;
— centered longitudinal;
— matched transverse;
— matched longitudinal;
— matched transverse andlongitudinal;
— relative.

NOTE - See 4.2.111.1.1 - 4.2.111.1.14 for the definition of each allowable value for relationship_type.

4.2.118.1.1 forward longitudinal extent:
4.2.118.1.2 aft longitudinal extent:
4.2.118.1.3 port transverse extent:
4.2.118.1.4 starboard transverse extent:
4.2.118.1.5 forward starboard corner:
4.2.118.1.6 forward port corner:
4.2.118.1.7 aft starboard corner:
4.2.118.1.8 aft port corner:
4.2.118.1.9 centered transverse:
4.2.118.1.10 centered longitudinal:
4.2.118.1.11 matched transverse:
4.2.118.1.12 matched longitudinal:
4.2.118.1.13 matched transverse_and_longitudinal:
4.2.118.1.14 relative: the locations of the two Spaces are fixed relative to one another.

4.2.119 Space_relationship

A Space_relationship is a type of Item_relationship (see) that represents an association between two Spaces. A Space_relationship shall be either a Space_adjacency_relationship (see), a Space_functional_relationship (see), a Space_connection_relationship (see), a Space_positional_relationship (see), or a Space_enclosing_relationship (see). The collection of instances of any particular category of relationships defines a network of inter-related spaces that can be used for automated generation of ship arrangements.

The data associated with a Space_relationship are the following:

— item_1;

— item_2;

— remark.

4.2.119.1 item_1

The item_1 specifies the redeclaration of the first items attribute inherited from Item_relationship in order to constrain it to be the relating Space.

4.2.119.2 item_2

The item_2 specifies the redeclaration of the second item attribute inherited from Item_relationship in order to constrain it to be the related Space.

4.2.119.3 remark

The remark specifies the textual information used to further define the relationship between two related Spaces.

4.2.120 Space

A Space is a collection of other spaces and parts within a defined volume on board a ship. A Space may be either a Compartment (see) or a Zone (see). A Space is an item and as such may have a design definition relating applicable properties to the Space. The Space is also an Item structure, which provides Product Structuring capability to relate a Space to the Parts or other Spaces contained within it. In this way, Space specifies how the details of a ship, such as pipes, plates, profiles, or cableways, shall be collected into blocks of the ship, by zone or compartment units.

EXAMPLE 12 - A Zone is a type of Space. The Item_structure for the Zone may gather the Compartments contained within that Zone, as well as additional Parts.

EXAMPLE 13 - A Compartment is a type of Space. The Item_structure for the Compartment may gather the Structural, Piping, or Machinery Parts contained within the Compartment.

Spaces have tree structures and shall not be cyclic. This means that a Space shall not be referenced by itself

directly or indirectly, that is via the relationships that it consists of.
The data associated with a Space are the following:

— description;

— items;

— name;

— relationships.

4.2.120.1 description

The description specifies the textual information used to further define or enumerate the space.

4.2.120.2 items

The items specifies the redeclaration of items attribute inherited from Item_structure in order to constrain it to be of type Part or Space. A Space shall not reference itself in the set of items.

4.2.120.3 name

The name specifies the textual information used to refer to a particular space. It should be unique within the scope of a single ship.

4.2.120.4 relationships

The relationships specifies the redeclaration of relationships attribute inherited from Item_structure in order to constrain it to be of type Part_relationship or Space_relationship. A Space shall not reference itself in the set of relationships.

4.2.121 Spacing_grid_definition

A Spacing_grid_definition is a type of General_characteristics_definition (see) that describes the set of longitudinal, transverse and vertical Spacing_tables that are applicable to the Ship. There is only one Spacing_grid_definition defined for a Ship.
The data associated with a Spacing_grid_definition are the following:

— axes_in_grid.

The axes_in_grid specifies the collection of Spacing_tables that together provide reference positions along the axes of the Ship. There may be more than one axes_in_grid for a Spacing_grid_definition

4.2.122 Spacing_position

A Spacing_position is a position on one of the coordinate axes of the ship that is used as a reference point during the design and manufacture of the ship.
The data associated with a Spacing_position are the following:

— location;

— name;

— position_number.

4.2.122.1 location

The location specifies the distance of the Spacing_position from the base of the After Perpendicular.

4.2.122.2 name

The name specifies the shipbuilding related term that is used to label the reference point. The name need not be specified for a particular Spacing_position.

4.2.122.3 position_number

The position_number specifies the unique numerical identification given to the Spacing_position. The position_number need not be specified for a particular Spacing_position.

4.2.123 Spacing_table

A Spacing_table is a collection of Spacing_positions that define a list of reference points along one of the coordinate axes of the Ship. The function of the Spacing_table is given by the table_usage.
EXAMPLE 13 - A frame spacing table is a type of Spacing_table. The frame numbers would be specified as table_positions and the fact that the table was a frame spacing table would be given by the value for table_usage.
The data associated with a Spacing_table are the following:

— description;

— name;
— table_positions;
— table_usage.

4.2.123.1 description

The description specifies the textual account of the reason why the Spacing_table was created and any additional text that is required to describe the purpose of the Spacing_table. The description need not be specified for a particular Spacing_table.

4.2.123.2 name

The name specifies the context specific identification for the Spacing_table. The name need not be specified for a particular Spacing_table.

4.2.123.3 table_positions

The table_positions specifies the positions on the coordinate axis that are of interest. There may be more than one table_positions in for a particular Spacing_table

4.2.123.4 table_usage

The table_usage specifies the purpose of the Spacing_table within the context of the design and manufacture of a ship.
The value of the table_usage shall be one of the following:

— frame table;
— buttock table;
— station table;
— waterline table;
— user defined table.

NOTE - See 4.2.116.4.1 - 4.2.116.4.5 for the definition of each allowable value for table_usage.

4.2.123.4.1 frame table: a table whose positions are a reference for the location of the ship's frames.

4.2.123.4.2 buttock table: a table of transverse positions that are a reference for buttock lines.

4.2.123.4.3 station table: a table of longitudinal positions that are a reference for stations.

4.2.123.4.4 waterline table: a table of vertical positions that are a reference for waterlines.

4.2.123.4.5 user defined table: the table type is defined by the user_def_function attribute.

4.2.124 Surface

A Surface is a type of Geometric_representation_item (see) that is a set of mathematical points which is the image of a continuous function defined over a connected subset of the real plane. The specific geometry that is allowed for Surface is described by the following subtypes:

— bounded_surface;
— elementary_surface;
— offset_surface;
— Ship_surface (see);
— surface_replica;
— swept_surface.

4.2.125 Tank_compartment_design_definition

A Tank_compartment_design_definition is a type of Compartment_design_definition (see) which provides the abstract definition of a version of a Tank_compartment from a design perspective. The Tank_compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Tank_compartment.

The data associated with a Tank_compartment_design_definition are the following:

— tank_compartment_properties.

The tank_compartment_properties specifies the reference to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Tank_compartment.

4.2.126 Tank_compartment_functional_definition

The Tank_compartment_functional_definition is the functional role of a Tank_compartment; the role may be a pre-defined one or may be user-defined.

The data associated with a Tank_compartment_functional_definition are the following:

— used_for.

The used_for specifies the name of a function that a specific Tank_compartment may have in a ship.

The value of the used_for shall be one of the following:

— liquid cargo;

— ballast water;

— oil fuel;

— potable water;

— waste;

— jet fuel;

— user defined.

NOTE - See 4.2.118.1 - 4.2.118.7 for the definition of each allowable value for used_for.

4.2.126.1 liquid cargo: the Tank_compartment is designed to carry liquid cargo.

4.2.126.2 ballast water: the Tank_compartment is designed to carry ballast water.

4.2.126.3 oil fuel: the Tank_compartment is designed to carry oil or fuel.

4.2.126.4 potable water: the Tank_compartment is designed to carry potable water.

4.2.126.5 waste: the Tank_compartment is designed to carry waste.

4.2.126.6 jet fuel: the Tank_compartment is designed to carry jet fuel.

4.2.126.7 user defined: the use of the Tank_compartment is defined by the user_def_function attribute.

4.2.127 Tank_compartment_property_set

The Tank_compartment_property_set is a collection of properties for Compartments designated for carrying fluid cargo such as oil or fuel.

The data associated with a Tank_compartment_property_set are the following:

— design_properties;

— design_stowage_density;

— geometric_parameters;

— liquid_capacity;

— moments_of_inertia.

4.2.127.1 design_properties

The design_properties is optional and, if present, specifies the

4.2.127.2 design_stowage_density

The design_stowage_density specifies the measure of the quantity per unit volume of the liquid cargo for which the Tank_compartment is designed.

4.2.127.3 geometric_parameters

The geometric_parameters specifies a set of geometric area, length, and location properties that provide information about the tank. A geometric_parameters need not be specified for a particular Tank_compartment_property_set.

4.2.127.4 liquid_capacity

The liquid_capacity specifies the volume of the tank.

4.2.127.5 moments_of_inertia

The moments_of_inertia specifies the design moments of inertia for the tank.

4.2.128 Tank_compartment

A Tank_compartment is a compartment which is designated primarily for the storage of liquids used in the mission of the ship, or for the storage of liquid cargos transported by the ship.

EXAMPLE 14 - Fuels for propulsion of the ship, potable water for the passengers and crew, waste products, petroleum product cargo, and fuel for aircraft supported by the ship are carried in Tank compartments.

The data associated with a Tank_compartment are the following:

— roles.

The roles specifies that the intended usage for a Tank_compartment shall be of type Tank_compartment_functional_definition.

4.2.129 Tank_geometric_parameters

Tank_geometric_parameters describes geometric properties of the Tank_compartment used for analysis of fluid cargo sloshing.

The data associated with a Tank_geometric_parameters are the following:

— aft_end;
— breadth_at_bottom;
— breadth_at_top;
— breadth_wash;
— forward_end;
— length_of;
— length_wash;
— uppermost_port;
— uppermost_starboard.

4.2.129.1 aft_end

The aft_end specifies the location of the aft end of the tank, a length value parallel to the global X coordinate axis of the ship.

4.2.129.2 breadth_at_bottom

The breadth_at_bottom specifies the breadth of the compartment at the compartment bottom.

4.2.129.3 breadth_at_top

The breadth_at_top specifies the breadth of the compartment at the compartment top.

4.2.129.4 breadth_wash

The breadth_wash specifies the breadth between effective wash bulkheads at the height of the load point. A breadth_wash need not be specified for a particular Tank_geometric_parameters.

4.2.129.5 forward_end

The forward_end specifies the location of the forward end of the tank, a length value parallel to the global X coordinate axis of the ship.

4.2.129.6 length_of

The length_of specifies the overall length of the Tank parallel to the global X coordinate axis of the ship.

4.2.129.7 length_wash

The length_wash specifies the length between effective wash bulkheads at the height of the load point. A length_wash need not be specified for a particular Tank_geometric_parameters.

4.2.129.8 uppermost_port

The uppermost_port specifies the uppermost tank dimension to port side.

4.2.129.9 uppermost_starboard

The uppermost_starboard specifies the uppermost tank dimension to starboard side.

4.2.130 Tank_piping_design_properties

The Tank_piping_design_properties is a collection of information about the piping in a tank that impact damaged stability calculations and the design of the tank structural.

The data associated with a Tank_piping_design_properties are the following:

- airpipe_height;
- filling_height;
- relief_valve_pressure_setting;
- sounding_pipe_height.

4.2.130.1 airpipe_height

The airpipe_height specifies the height from the base line to the top of the air pipe. An airpipe_height need not be specified for a particular Tank_piping_design_properties.

4.2.130.2 filling_height

The filling_height specifies the height of maximum filling of the Tank_compartment. A filling_height need not be specified for a particular Tank_piping_design_properties.

4.2.130.3 relief_valve_pressure_setting

The relief_valve_pressure_setting specifies the pressure valve opening pressure. A relief_valve_pressure_setting need not be specified for a particular Tank_piping_design_properties.

4.2.130.4 sounding_pipe_height

The sounding_pipe_height specifies the height of the sounding pipe in the tank.

4.2.131 Technical_description

A Technical_description is a textual description or specification of a product to be designed and possibly manufactured.

NOTE - When a Technical_description is created, the related ship exists only in the imaginations of the designers. Therefore this information is not specific with respect to product items, because they are not yet defined, but it is very specific with respect to the expectations of the owner and designers.

4.2.132 Tonnage_definition

A Tonnage_definition is a method of volume calculation applied to ships. It is used for determining charges for facilities such as berthing, docking, and passage through canals and locks.

The data associated with a Tonnage_definition are the following:

- certificate;
- compensated_gross_tonnage;
- gross_tonnage;
- net_tonnage;
- spaces_excluded;
- tonnage_regulation.

4.2.132.1 certificate

The certificate specifies the document which is issued to the ship owner by the authority which carried out the tonnage calculations.

4.2.132.2 compensated_gross_tonnage

The compensated_gross_tonnage specifies the gross_tonnage value compensated for the type and complexity of the vessel.

4.2.132.3 gross_tonnage

The gross_tonnage specifies the value and derivation of the gross tonnage calculation.

4.2.132.4 net_tonnage

The net_tonnage specifies the value and derivation of the net tonnage calculation.

4.2.132.5 spaces_excluded

The spaces_excluded specifies the spaces which were excluded from the tonnage calculations.

4.2.132.6 tonnage_regulation

The tonnage_regulation specifies the regulations which were used to produce the tonnage calculations.
The value of the tonnage_regulation shall be one of the following:

— suez;
— panama;
— convention1969;
— other.

NOTE - See 4.2.124.6.1 - 4.2.124.6.4 for the definition of each allowable value for type_of.

4.2.132.6.1 suez: the Suez tonnage regulations were used to produce the tonnage calculations.

4.2.132.6.2 panama: the Panama tonnage regulations were used to produce the tonnage calculations.

4.2.132.6.3 convention1969: the convention1969 tonnage regulations were used to produce the tonnage calculations.

4.2.132.6.4 other: some other tonnage regulations were used to produce the tonnage calculations.

4.2.133 Tonnage_measurement

A tonnage_measurement is the definition of a tonnage calculation and the spaces which were included to obtain that measurement.
The data associated with a Tonnage_measurement are the following:

— date_of_measurement;
— spaces_included;
— tonnage_value.

4.2.133.1 date_of_measurement

The date_of_measurement specifies the date that the certifying organization calculated the tonnage for a vessel.

4.2.133.2 spaces_included

The spaces_included specifies the compartments used in the derivation of the tonnage value.

4.2.133.3 tonnage_value

The tonnage_value specifies the numerical value resulting from the tonnage calculation.

4.2.134 Unit_cargo_assignment

A Unit_cargo_assignment is a type of Compartment_cargo_assignment (see). It is a consignment of unit cargo which has been allocated and loaded into a compartment.
The data associated with an Unit_cargo_assignment are the following:

— position;
— unit_cargo_identifier.

4.2.134.1 position

The position specifies the position of the Unit_cargo within the compartment where it has been loaded.

4.2.134.2 unit_cargo_identifier

The unit_cargo_identifier specifies the label used to identify a particular unit cargo.

4.2.135 Unit_cargo

A Unit_cargo is a type of Dry_cargo (see). It is cargo which is packed or comprises discrete units which can be loaded and stored individually.
The data associated with an Unit_cargo are the following:

— bounding_space;
— footprints;
— lashing_points;

— shape_description;
— stack_limit;
— type_of;
— volume;
— weight_and_centre_of_gravity.

4.2.135.1 bounding_space

The bounding_space specifies the description of the total space needed for stowage of the Unit_cargo. This may be the same as the shape_description but may also include the surrounding space required for inspection and maintenance.

4.2.135.2 footprints

The footprints specifies the description of the areas of the Unit_cargo which are in contact with the ship deck or hanging point.

4.2.135.3 lashing_points

The lashing_points specifies the points at which lashings are secured to the Unit_cargo. These points are specified in the local_coordinate system of the Unit_cargo.

4.2.135.4 shape_description

The shape_description specifies the definition of the true shape of the Unit_cargo.

4.2.135.5 stack_limit

The stack_limit specifies the maximum number of this type of Unit_cargo which can be stacked on top of each other. A stack_limit need not be specified for a particular Unit_cargo.

4.2.135.6 type_of

The type_of specifies the type of unit cargo.
The value of the type_of shall be one of the following:

— vehicle;
— boat;
— trailer;
— container;
— general;
— cable;
— livestock;
— aircraft;
— drums;
— pallet.

NOTE - See 4.2.127.6.1 - 4.2.127.6.10 for the definition of each allowable value for type_of.

4.2.135.6.1 vehicle: the unit cargo is a vehicle.

4.2.135.6.2 boat: the unit cargo is a boat.

4.2.135.6.3 trailer: the unit cargo is a trailer.

4.2.135.6.4 container: the unit cargo is a container.

4.2.135.6.5 general: the unit cargo is of a general, unspecified type.

4.2.135.6.6 cable: the unit cargo is a cable.

4.2.135.6.7 livestock: the unit cargo is livestock.

4.2.135.6.8 aircraft: the unit cargo is an aircraft.

4.2.135.6.9 drums: the unit cargo is drums.

4.2.135.6.10 pallet: the unit cargo is a pallet.

4.2.135.7 volume

The volume specifies the volume of the Unit_cargo.

4.2.135.8 weight_and_centre_of_gravity

The weight_and_centre_of_gravity specifies the definition of the Unit_cargo's local coordinate system, weight and centre of gravity with respect to that local coordinate system, whose origin is at the base of the centre of plane area of the cargo.

4.2.136 Universal_resource_locator

The Universal_resource_locator is the address of an electronic data source such as an Internet address. This is an alternative to the common postal address as provided by ISO 10303/41.

The data associated with a Universal_resource_locator are the following:

- location;
- machine_address;
- other_protocol_type;
- port;
- protocol;
- protocol_is_specified.

4.2.136.1 location

The location specifies the directory path on the target machine where the document is located.

4.2.136.2 machine_address

The machine_address specifies the name of the target machine that provides the service. This could be an FTP server name or an Internet address.

4.2.136.3 other_protocol_type

The other_protocol_type specifies the transmission protocol if different from those specified in the protocol attribute. An other_protocol_type need not be specified for a particular Universal_resource_locator.

4.2.136.4 port

The port specifies a non-standard port number if applicable. A port need not be specified for a particular Universal_resource_locator.

4.2.136.5 protocol

The protocol specifies the type of the transmission protocol.

NOTE - Because there are continual changes to available protocol types, a protocol type user_defined is included and the optional other_protocol_type attribute is used to hold the protocol type in this case.

The value of the protocol shall be one of the following:

- HTTP;
- FTP;
- GOPHER;
- NEWS;
- user_defined.

NOTE - See 4.2.128.5.1 - 4.2.128.5.5 for the definition of each allowable value for protocol.

4.2.136.5.1 HTTP:

4.2.136.5.2 FTP:

4.2.136.5.3 GOPHER:

4.2.136.5.4 NEWS:

4.2.136.5.5 user_defined: some other transfer protocol, whose type is communicated using the other_protocol_type attribute.

4.2.136.6 protocol_is_specified

The protocol_is_specified specifies whether or not the protocol for transfer is specified.

4.2.137 Version_history

A Version_history identifies Definitions and their Version_relationships. The Version_history is be a

directed acyclic graph. The Version_history may contain Definitions considered alternatives with respect to each other (a Definition having more than one successor), and merged Definitions (a Definition having more than one predecessor).
The data associated with a Version_history are the following:

— current_version;
— relationships;
— versions.

4.2.137.1 current_version

The current_version specifies the Definition which plays the role of the Current_version in a Version_history.

4.2.137.2 relationships

The relationships specifies the Version_relationships the Version_history consists of.

4.2.137.3 versions

The versions specifies the Definitions the Version_history consists of.

4.2.138 Version_relationship

A Version_relationship is a relationship between two Definitions of the same type.
The data associated with a Version_relationship are the following:

— predecessor;
— reason;
— successor.

4.2.138.1 predecessor

The predecessor specifies the version the successor is derived from.

4.2.138.2 reason

The reason specifies the reason for creating a new version, created by a certain person at a certain time.

4.2.138.3 successor

The successor specifies the version the predecessor is the preceding version of.

4.2.139 Void_compartment_design_definition

A Void_compartment_design_definition is a type of Compartment_design_definition (see) which provides the abstract definition of a version of a Void_compartment from a design perspective. The Void_compartment_design_definition gathers references to the design requirements, applicable design properties, cargo loadings which effect the compartment design, and the geometric representation for the Void_compartment.
The data associated with a Void_compartment_design_definition are the following:

— void_compartment_properties.

The void_compartment_properties specifies the reference to an appropriate set of physical, administrative, or geometric properties that apply to the design of a Void_compartment.

4.2.140 Void_compartment_functional_definition

The Void_compartment_functional_definition is the functional role of a Void_compartment. The role may be a pre-defined one or may be user-defined.
The data associated with a Void_compartment_functional_definition are the following:

— used_for.

The used_for specifies the name of a function that a specific Void_compartment may have in a ship.
The value of the used_for shall be one of the following:

— void;
— cofferdam;
— trunk;
— shaft alley;
— user defined.

NOTE - See 4.2.132.1 - 4.2.132.5 for the definition of each allowable value for used_for.

4.2.140.1 void: the Void_compartment is designed to be used as a void space.

4.2.140.2 cofferdam: the Void_compartment is designed to be used as a cofferdam.

4.2.140.3 trunk: the Void_compartment is designed to be used as a trunk.

4.2.140.4 shaft alley: the Void_compartment is designed to be used as a shaft alley.

4.2.140.5 user defined: the use of the Void_compartment is defined by the user_def_function attribute.

4.2.141 Void_compartment

A Void_compartment is a Compartment (see) which is never used to carry cargo or intended to be occupied by humans. The main purpose of a Void_compartment is for segregating the cargo or to create space for emergency access to other spaces.

The data associated with a Void_compartment are the following:

— roles.

The roles specifies the roles that a void_compartment may play shall be of type Void_compartment_functional_definition.

4.2.142 Weight_and_centre_of_gravity

A Weight_and_centre_of_gravity is the weight and possibly the centre of gravity of a ship part. The moment components will be derived if the moment origin exists.

The data associated with a Weight_and_centre_of_gravity are the following:

— centre_of_gravities;

— local_co_ordinate_system;

— moments;

— operating_condition;

— weights.

4.2.142.1 centre_of_gravities

The centre_of_gravities specifies the centre of gravities of a ship part.

4.2.142.2 local_co_ordinate_system

The local_co_ordinate_system_ specifies the local co-ordinate system on which the centre_of_gravities references.

4.2.142.3 moments

The moments specifies the moments based on centre_of_gravity and weight.

4.2.142.4 operating_condition

The operating_condition specifies the condition under which the weight and centre_of_gravities are obtained. An operating_condition need not be specified for a particular Weight_and_centre_of_gravity.

4.2.142.5 weights

The weights specifies the weight of a ship part.

4.2.143 Zone_design_definition

The Zone_design_definition is the abstract definition of a version of a Zone from a design perspective. The Zone_design_definition gathers references to the design requirements and the geometric representation for the Compartment.

The data associated with a Zone_design_definition are the following:

— governed_by_design_requirement;

— representation.

4.2.143.1 governed_by_design_requirement

The governed_by_design_requirement specifies the reference to a description or formal specification that represents a constraint placed on the design.

4.2.143.2 representation

The representation specifies the redefinition of the representation attribute: a Zone_design_definition shall

only have Compartment_shape_ representations.

4.2.144 Zone_function

The Zone_function is the functional role of a Zone. The role may be a pre-defined one or may be user-defined.

The data associated with a Zone_function are the following:

— used_for.

The used_for specifies the name of a function that a specific Zone may have in a ship.

The value of the used_for shall be one of the following:

— subsafe zone;

— pressure zone;

— fire zone;

— design zone;

— damage controlzone;

— arrangement zone;

— user defined.

NOTE - See 4.2.136.1 - 4.2.136.7 for the definition of each allowable value for used_for.

4.2.144.1 subsafe zone: the Zone is defined to be a subsafe zone.

4.2.144.2 pressure zone: the Zone is defined to be a pressure zone.

4.2.144.3 fire zone: the Zone is defined to be a fire zone.

4.2.144.4 design zone: the Zone is defined to be a design zone.

4.2.144.5 damage control zone: the Zone is defined to be a damage control zone.

4.2.144.6 arrangement zone: the Zone is defined to be an arrangement zone.

4.2.144.7 user defined: the Zone function is defined by the user_def_function attribute.

4.2.145 Zone

A Zone is a type of Space that represents an abstract bounded volume identifying a region of a ship with unique requirements or characteristics which must be specially treated in the design or manufacturing process.

EXAMPLE 15 - Zones carry designations as Design Zone, Fire Zone, CPS Zone, Subsafe Zone, and Ship Work Authorization Boundary Zone.

The data associated with a Zone are the following:

— roles.

The roles specifies that the roles that a Zone may play shall be of type Zone_function.

4.3 Application assertions

4.3.1 Approval_history to Definition

An Approval_history refers to exactly one Definition. A Definition defines the subject of an Approval_history.

4.3.2 Approval_relationship to Approval_history

An Approval_relationship refers to exactly one Approval_history. An Approval_history defines the approval_context of an Approval_relationship.

4.3.3 Approval_relationship to Approval_relationship_event

An Approval_relationship refers to one up to many Approval_relationship_events. A list of Approval_relationship_events defines the approval_relationship_history of an Approval_relationship.

4.3.4 Approval_stucture to Approval_history

An Approval_stucture refers to zero up to many Approval_historys. A set of Approval_historys defines the meaning of an Approval_stucture.

4.3.5 Bay_cell_position to Cargo_bay_definition

A Bay_cell_position refers to exactly one Cargo_bay_definition. A Cargo_bay_definition defines the

relating_to of a Bay_cell_position.

4.3.6 Cargo_compartment_design_definition to Cargo_bay_definition

A Cargo_compartment_design_definition refers to zero or one Cargo_bay_definition. A Cargo_bay_definition defines the cargo_bay of a Cargo_compartment_design_definition.

4.3.7 Change_impact to Definition_change_event

A Change_impact refers to one up to many Definition_change_events. A set of Definition_change_events defines the impact of a Change_impact.

4.3.8 Change_realization to Change_impact

A Change_realization refers to exactly one Change_impact. A Change_impact defines the impact of a Change_realization.

4.3.9 Change_realization to Check

A Change_realization refers to zero up to many Checks. A set of Checks defines the checks of a Change_realization.

4.3.10 Change_request to Change_impact

A Change_request refers to zero up to many Change_impacts. A set of Change_impacts defines the solution_alternatives of a Change_request.

4.3.11 Change_state to Change

A Change_state refers to exactly one Change. A Change defines the change_reference of a Change_state.

4.3.12 Coating to Coating_certification

A Coating refers to zero up to many Coating_certifications. A set of Coating_certifications defines the certification of a Coating.

4.3.13 Coating_certification to Coating

A Coating_certification refers to exactly one Coating. A Coating defines the certifying_organisation of a Coating_certification.

4.3.14 Coating_certification to Coating

A Coating_certification refers to exactly one Coating. A Coating defines the expiry_date of a Coating_certification.

4.3.15 Compartment_cargo_assignment to Compartment

A Compartment_cargo_assignment refers to exactly one Compartment. A Compartment defines the compartment of a Compartment_cargo_assignment.

4.3.16 Compartment_cargo_assignment to Ship_cargo

A Compartment_cargo_assignment refers to exactly one Ship_cargo. A Ship_cargo defines the cargo of a Compartment_cargo_assignment.

4.3.17 Compartment_design_definition to Compartment_property_set

A Compartment_design_definition refers to zero up to many Compartment_property_sets. A set of Compartment_property_sets defines the properties of a Compartment_design_definition.

4.3.18 Compartment_design_definition to Ship_cargo

A Compartment_design_definition refers to zero up to many Ship_cargos. A set of Ship_cargos defines the applicable_cargos of a Compartment_design_definition.

4.3.19 Compartment_group to Compartment

A Compartment_group refers to zero up to many Compartments. A set of Compartments defines the compartment of a Compartment_group.

4.3.20 Compartment_shape_representation_3d to Moulded_form

A Compartment_shape_representation_3d refers to zero up to many Moulded_forms. A set of Moulded_forms defines the compartment_boundaries of a Compartment_shape_representation_3d.

4.3.21 Compensated_gross_tonnage to Gross_tonnage

A Compensated_gross_tonnage refers to exactly one Gross_tonnage. A Gross_tonnage defines the gross_tonnage_measurement of a Compensated_gross_tonnage.

4.3.22 Corrosion_protection to Coating

A Corrosion_protection refers to zero or one Coating. A Coating defines the example of a Corrosion_protection.

4.3.23 Deadweight to Cargo_assignment

A Deadweight refers to one up to many Cargo_assignments. A set of Cargo_assignments defines the deadweight_items of a Deadweight.

4.3.24 Deck_cargo_assignment to Cargo_position

A Deck_cargo_assignment refers to exactly one Cargo_position. A Cargo_position defines the position of a Deck_cargo_assignment.

4.3.25 Deck_cargo_assignment to Unit_cargo

A Deck_cargo_assignment refers to exactly one Unit_cargo. An Unit_cargo defines the cargo of a Deck_cargo_assignment.

4.3.26 Definition_creation to Definition

A Definition_creation refers to zero up to many Definitions. A set of Definitions defines the base of a Definition_creation.

4.3.27 Definition_creation to Definition

A Definition_creation refers to exactly one Definition. A Definition defines the subject of a Definition_creation.

4.3.28 Definition_deletion to Definition

A Definition_deletion refers to exactly one Definition. A Definition defines the subject of a Definition_deletion.

4.3.29 Definition_modification to Definition

A Definition_modification refers to exactly one Definition. A Definition defines the subject of a Definition_modification.

4.3.30 Definition_relationship to Definition

A Definition_relationship refers to exactly one Definition. A Definition defines the definition_1 of a Definition_relationship.

4.3.31 Definition_relationship to Definition

A Definition_relationship refers to exactly one Definition. A Definition defines the definition_2 of a Definition_relationship.

4.3.32 Envisaged_definition_creation to Definition

An Envisaged_definition_creation refers to zero up to many Definitions. A set of Definitions defines the base of an Envisaged_definition_creation.

4.3.33 Fire_safe_coating to Primer_coating

A Fire_safe_coating refers to exactly one Primer_coating. A Primer_coating defines the bs476 of a Fire_safe_coating.

4.3.34 General_characteristics_definition to Ship

A General_characteristics_definition refers to one up to many Ships. A set of Ships defines the defined_for of a General_characteristics_definition.

4.3.35 General_compartment_property_set to Compartment_naval_administrative_properties

A General_compartment_property_set refers to zero or one Compartment_naval_administrative_properties. A Compartment_naval_administrative_properties defines the naval_administrative_properties of a General_compartment_property_set.

4.3.36 General_compartment_property_set to Compartment_volume

A General_compartment_property_set refers to exactly one Compartment_volume. A Compartment_volume defines the volume of a General_compartment_property_set.

4.3.37 Item_relationship to Item
An Item_relationship refers to exactly one Item. An Item defines the item_1 of an Item_relationship.

4.3.38 Item_relationship to Item
An Item_relationship refers to exactly one Item. An Item defines the item_2 of an Item_relationship.

4.3.39 Item_structure to Item
An Item_structure refers to zero up to many Items. A set of Items defines the items of an Item_structure.

4.3.40 Item_structure to Item_relationship
An Item_structure refers to zero up to many Item_relationships. A set of Item_relationships defines the item_relationships of an Item_structure.

4.3.41 Lane_position to Cargo_bay_definition
A Lane_position refers to exactly one Cargo_bay_definition. A Cargo_bay_definition defines the relating_to of a Lane_position.

4.3.42 Loading_condition_definition to Cargo_assignment
A Loading_condition_definition refers to one up to many Cargo_assignments. A set of Cargo_assignments defines the cargo_loads of a Loading_condition_definition.

4.3.43 Loading_condition_definition to Deadweight
A Loading_condition_definition refers to exactly one Deadweight. A Deadweight defines the deadweight of a Loading_condition_definition.

4.3.44 Loading_condition_definition to Floating_position
A Loading_condition_definition refers to exactly one Floating_position. A Floating_position defines the floating_position of a Loading_condition_definition.

4.3.45 Moulded_form_relationship to Moulded_form
A Moulded_form_relationship refers to exactly one Moulded_form. A Moulded_form defines the item_1 of a Moulded_form_relationship.

4.3.46 Moulded_form_relationship to Moulded_form
A Moulded_form_relationship refers to exactly one Moulded_form. A Moulded_form defines the item_2 of a Moulded_form_relationship.

4.3.47 Part_relationship to Part
A Part_relationship refers to exactly one Part. A Part defines the item_1 of a Part_relationship.

4.3.48 Part_relationship to Part
A Part_relationship refers to exactly one Part. A Part defines the item_2 of a Part_relationship.

4.3.49 Reference_position to Definition
A Reference_position refers to exactly one Definition. A Definition defines the current_version of a Reference_position.

4.3.50 Reference_position to Definition
A Reference_position refers to one up to many Definitions. A set of Definitions defines the versions of a Reference_position.

4.3.51 Reference_position to Version_relationship
A Reference_position refers to zero up to many Version_relationships. A set of Version_relationships defines the relationships of a Reference_position.

4.3.52 Ship to External_reference
A Ship refers to zero or one External_reference. An External_reference defines the documentation of a Ship.

4.3.53 Ship_cargo to Cargo_material_properties
A Ship_cargo refers to zero or one Cargo_material_properties. A Cargo_material_properties defines the material_properties of a Ship_cargo.

4.3.54 Ship_cargo to Dangerous_goods_code

A Ship_cargo refers to zero or one Dangerous_goods_code. A Dangerous_goods_code defines the cargo_hazard of a Ship_cargo.

4.3.55 Ship_cargo to Document_reference

A Ship_cargo refers to zero up to many Document_references. A set of Document_references defines the references of a Ship_cargo.

4.3.56 Ship_cargo to Ship

A Ship_cargo refers to exactly one Ship. A Ship defines the description of a Ship_cargo.

4.3.57 Space_adjacency_relationship to Adjacent_space_surface_area

A Space_adjacency_relationship refers to exactly one Adjacent_space_surface_area. An Adjacent_space_surface_area defines the adjacent_space_surface_area of a Space_adjacency_relationship.

4.3.58 Space_relationship to Part_relationship

A Space_relationship refers to zero up to many Part_relationships. A set of Part_relationships defines the atomic_relationships of a Space_relationship.

4.3.59 Space_relationship to Space

A Space_relationship refers to exactly one Space. A Space defines the item_1 of a Space_relationship.

4.3.60 Space_relationship to Space

A Space_relationship refers to exactly one Space. A Space defines the item_2 of a Space_relationship.

4.3.61 Tank_compartment_property_set to Capacity_properties

A Tank_compartment_property_set refers to zero up to many Capacity_propertieses. A set of Capacity_propertieses defines the liquid_capacity of a Tank_compartment_property_set.

4.3.62 Tank_compartment_property_set to Tank_piping_design_properties

A Tank_compartment_property_set refers to zero or one Tank_piping_design_properties. A Tank_piping_design_properties defines the design_properties of a Tank_compartment_property_set.

4.3.63 Tank_property_rules to Arrangement_item_description

A Tank_property_rules refers to exactly one Arrangement_item_description. An Arrangement_item_description defines the description of a Tank_property_rules.

4.3.64 Tank_property_rules to Item_structure

A Tank_property_rules refers to exactly one Item_structure. An Item_structure defines the example of a Tank_property_rules.

4.3.65 Tank_property_rules to Ship

A Tank_property_rules refers to exactly one Ship. A Ship defines the name of a Tank_property_rules.

4.3.66 Tonnage_definition to Compensated_gross_tonnage

A Tonnage_definition refers to exactly one Compensated_gross_tonnage. A Compensated_gross_tonnage defines the compensated_gross_tonnage of a Tonnage_definition.

4.3.67 Tonnage_definition to Document

A Tonnage_definition refers to exactly one Document. A Document defines the note of a Tonnage_definition.

4.3.68 Tonnage_definition to Gross_tonnage

A Tonnage_definition refers to exactly one Gross_tonnage. A Gross_tonnage defines the gross_tonnage of a Tonnage_definition.

4.3.69 Tonnage_measurement to Compartment_group

A Tonnage_measurement refers to zero up to many Compartment_groups. A set of Compartment_groups defines the spaces_included of a Tonnage_measurement.

4.3.70 Unit_cargo to Weight_and_centre_of_gravity

An Unit_cargo refers to exactly one Weight_and_centre_of_gravity. A Weight_and_centre_of_gravity

defines the weight_and_centre_of_gravity of an Unit_cargo.

4.3.71 Unit_cargo_assignment to Cargo_position

An Unit_cargo_assignment refers to exactly one Cargo_position. A Cargo_position defines the position of an Unit_cargo_assignment.

4.3.72 Universal_resource_locator to Arrangement_item_description

An Universal_resource_locator refers to one up to many Arrangement_item_descriptions. A set of Arrangement_item_descriptions defines the item_descriptions of an Universal_resource_locator.

4.3.73 Version_relationship to Definition

A Version_relationship refers to exactly one Definition. A Definition defines the predecessor of a Version_relationship.

4.3.74 Version_relationship to Definition

A Version_relationship refers to exactly one Definition. A Definition defines the successor of a Version_relationship.

4.3.75 Version_relationship to Event

A Version_relationship refers to exactly one Event. An Event defines the reason of a Version_relationship.

4.3.76 Void_compartment to Space

A Void_compartment refers to zero up to many Spaces. A set of Spaces defines the roles of a Void_compartment.

4.3.77 Weight_and_centre_of_gravity to Local_co_ordinate_system

A Weight_and_centre_of_gravity refers to exactly one Local_co_ordinate_system. A Local_co_ordinate_system defines the local_co_ordinate_system_ of a Weight_and_centre_of_gravity.

4.3.78 Weight_and_centre_of_gravity to Moment_3d

A Weight_and_centre_of_gravity refers to zero up to many Moment_3ds. A set of Moment_3ds defines the moments of a Weight_and_centre_of_gravity.

4.3.79 Zone to Zone_function

A Zone refers to zero up to many Zone_functions. A set of Zone_functions defines the example of a Zone.

4.3.80 Zone_design_definition to Compartment_shape_representation

A Zone_design_definition refers to exactly one Compartment_shape_representation. A Compartment_shape_representation defines the representation of a Zone_design_definition.

4.3.81 Remaining inverse attributes:

Entity habitable_compartment_design_definition: Attribute habitable_compartment is def by (attrib definitions):defined_for*Habitable_compartment FOR definitions
Entity compartment_design_definition: Attribute compartment is def by (attrib definitions):attribute*a Compartment_design_definition shall only have <Compartment_shape_ representation>s. *) -- INVERSE -- SELF\Definition.defined_for: Compartment FOR definitions
Entity version_history: Attribute change_state is def by (attrib change_reference). INVERSE possible_states: SET [1:3] OF Change_state FOR change_reference
Entity ship: Attribute definition is def by (attrib defined_for):definitions*SET OF Definition FOR defined_forEntity tank_compartment_design_definition: Attribute tank_compartment is def by (attrib definitions):defined_for*Tank_compartment FOR definitions
Entity machinery_compartment_design_definition: Attribute machinery_compartment is def by (attrib definitions):defined_for*Machinery_compartment FOR definitions
Entity cargo_compartment_design_definition: Attribute cargo_compartment is def by (attrib definitions):defined_for*Cargo_compartment FOR definitions
Entity approval_relationship: Attribute approval_relationship is def by (attrib approval_relationship_history) *)INVERSE approval_relationship_reference: Approval_relationship FOR approval_relationship_history
Entity void_compartment_design_definition: Attribute void_compartment is def by (attrib definitions):defined_for*Void_compartment FOR definitions
Entity zone_design_definition: Attribute compartment is def by (attrib definitions):attribute*a

Zone_design_definition shall only have <Compartment_shape_ representation>s. *) --INVERSE --
SELF\Definition.defined_for: Compartment FOR definitions
Entity item_structure: Attribute definition is def by (attrib defined_for):definitions*SET OF Definition FOR
defined_for

5. Application Interpreted Model

5.1 ARM to AIM Mapping

This section to be developed in CD version of the AP.

5.2 AIM EXPRESS Short Form

This section to be developed in CD version of the AP.

6. Conformance Requirements

6.1 Application Protocol Conformance Requirements

This section will be developed in future versions of the AP.

Annex F
(informative)
Application activity model

The application activity model (AAM) is provided to aid in understanding the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of the activities and the data, and a set of activity figures. The AAM covers activities which go beyond the scope of this application protocol.

The viewpoint of the application activity model is of an observer of the global ship development process. This activity model identifies the life cycle activities across all shipbuilding APs with extensions and emphasis appropriate to the Ship Arrangements. Activities relevant to the shipbuilding lifecycle that are not expanded in this activity model but are detailed in other shipbuilding application protocols.

F.1.1 approve general arrangements : This is the top level activity for the approval of the general arrangements. It is the entry activity for both the Design Approval Preview and checking against rules and regulations. NB The ship is not certified by this activity alone.

F.1.2 approved design : The approved design is the final design to be submitted as an offer.

F.1.3 arrangements : The arrangements of the ship are the ship's compartments and spaces. Any description of arrangements will include associated definitions of purpose for the compartment or space.

F.1.4 availability, reliability and maintainability information * : The information about the components that is required to install them in the ship and is required for planned maintenance.

F.1.5 basic hull parameters : Estimated principal dimensions based on historical data or preliminary design development.

F.1.6 calculate capacities : This activity includes the calculation of capacities of compartments and holds such as underdeck space, bunker space, tanks, machinery room and double bottom peak.

F.1.7 calculate capacities, holds, bunker space : Calculation of all separate capacities (see F.1.7). This could be done with the help of integral calculus or approximate formulae. For instance the hold capacity could be calculated from sectional areas and the integration over space's length.

F.1.8 calculate cost of ship * : This activity describes creation of negotiating documents based on technical product data and their estimated manufacturing cost. The results of this activity may contain sale price documents, financing support plan and documents describing funding and possible loans.

F.1.9 calculate lightship weight : This activity is necessary to summarise all relevant weight components. Together with the deadweight it is relevant for estimating the displacement.

F.1.10 calculate stability and trim : This activity deals with stability calculations (intact and damage stability), trim calculations, and calculations of centres of gravity in consideration of loading conditions.

F.1.11 calculate tonnage, freeboard : This activity deals with the calculation of tonnage and freeboard. As a result of the freeboard calculation a portion of ship volumes will be defined as reserve volumes.

F.1.12 calculate trim : This task involves the calculation of trim due to the weight of the ship and the weight and distribution of cargo.

F.1.13 calculate underdeck space : The calculation of all internal volumes.

F.1.14 cargo weights : The cargo weights used in defining loading conditions.

F.1.15 certificates * : The certificates issued by the Classification Society on completing the ship.

F.1.16 check arrangements for dangerous cargo : This activity checks for compliance with rule requirements with respect to arrangements for dangerous cargo (fire protection, detection, extinction, extinguisher).

F.1.17 check cofferdams and tank content : This activity checks the necessity for separating tanks from each other by cofferdams based on tank contents.

F.1.18 check design against rules and regulations : This is the top level activity for the approval of the primary design as part of the approval and certification process. The content of this activity is the same for all ships when it comes to conformance with Main Class Rules, but varies when it comes to additional class rules (type of vessel) and register notations. The activities performed are tailored to the rule requirements for general arrangement and global strength. This part of the approval is necessary before the yard can start ordering steel.

F.1.19 check internal doors and hatches for WT integrity : This activity checks for compliance with rule requirements with respect to doors and hatches and watertight integrity.

F.1.20 check position bulkheads : The checking of watertight integrity arrangements and stability conditions (intact and damage stability) to meet the relevant regulations given by Load Line conventions and the SOLAS convention.

F.1.21 check stability (intact, damage) : This activity includes the calculation of intact stability and damage stability. For the damage stability it is necessary to prove the buoyancy in damage conditions with the help of flooding curves (floodable and permissible length). The study of stability with calculation of different load conditions and damage conditions is necessary (i.e. lightship displacement and operation displacement).

F.1.22 Classification Society : An organisation that enhances the safety of life and property at sea by providing rules, regulations and personnel for assessing and classifying ships during their lifecycle.

F.1.23 cog and lightship weight : Summarise all centres of gravity and all weight components relevant for lightship weight.

F.1.24 complete and approve design of machinery * : The selection, arrangement and approval of the power plant in terms of the main engine, associated propulsion system and its auxiliary machinery.

F.1.25 complete and approve design of outfitting and distribution systems * : The selection and approval of the necessary outfitting equipment. The selection is based mainly on former designs and in accordance with the requirements. It also contains the layout of the different types of distribution systems such as piping and HVAC.

F.1.26 complete and approve design of ship structure * : The completion and approval of the ship structural design.

F.1.27 complete and approve ship design : The production and approval of ship design product data, documents and the classification drawings using the preliminary design from the bid preparation, as well as the required rules and regulations. The result of this activity is the approved design and the production and delivery schedule.

F.1.28 consultants : Organisations that provide specific services to shipyards, ship owners and classification societies during the ship lifecycle.

F.1.29 contract : The contract is the output from the activity which involves placing the order for the ship. The contract is used as a constraint in subsequent activities such as final design and approval and production.

F.1.30 cost * : The calculated cost of the ship based on the cost of material and labour.

F.1.31 create preliminary design : All design activities relevant in a very preliminary stage of ship design in consideration of classification rules, national/international demands, shipyard constraints and owner requirements. The aim of this task is to make a shipyard offer.

F.1.32 create preliminary general arrangements : The activity that produces the preliminary compartmentation plans from the preliminary hull form definition.

F.1.33 create preliminary hull form : The activity that is the first step of designing a ship. Using parent ships main dimensions and form parameters one or more preliminary hull forms will be generated.

F.1.34 create preliminary machinery design * : The activity that produces the preliminary designs for the ship machinery; including the prime mover, shaft system, fuel system, power systems and cargo handling equipment.

F.1.35 create preliminary outfitting design * : The activity that produces the preliminary design for the ship's outfitting, including distributed systems, such as piping and electrical systems.

F.1.36 create preliminary structure design * : The activity that produces the preliminary steel structure design, including the arrangement of the primary structural members.

F.1.37 Critical Design Areas : The areas requiring thorough investigation and conformity checking identified by the Design Approval Preview.

F.1.38 decide post-sales & maintenance support * : The activity that puts together the maintenance package for the ship. This is part of the tender document and includes the post sales support.

F.1.39 decommission and disassemble * : All activities relating to the last stage of the ship's lifecycle. It consists of the decommissioning and dismantling of the ship.

F.1.40 define compartments : This activity deals with a preliminary establishment of main parameters. Main particulars are length between perpendiculars, breadth, depth, draught, Deadweight, Displacement and block coefficient. Also form parameters will be established like prismatic coefficient, waterline coefficient, midship section coefficient and angle of entrance of waterline.

F.1.41 define loading conditions : This activity deals with the loading conditions and is necessary to ascertain the payload as a function of the available capacities.

F.1.42 design modifications : Comments and recommendations on the design (red-marking). This might be comments related to primary design or detail design solutions, safety arrangements, etc.

F.1.43 design schedule : Data that controls the time from the design phase to production.

F.1.44 distribution and outfitting design * : The design of the distribution systems (electrical and piping) and the outfitting.

F.1.45 estimate hydrodynamics and powering * : The activity that approximates hydrodynamic properties data calculations such as resistance, propulsion, seakeeping and manoeuvrability for the preliminary hull form.

F.1.46 estimate weight : This task is necessary for calculating the lightship weight and consists of the calculation of the hull steel weights, machinery weights and weights of outfitting and accommodation.

F.1.47 evaluate hull steel weights : This activity defines the estimated steel weight with the help of empirical values in a very preliminary stage of the design.

F.1.48 evaluate machinery weights : This activity defines all separate weights belonging to the machinery plant, including auxiliary equipment.

F.1.49 evaluate request & schedule bid * : This describes the activities of the shipyard when evaluating the inquiry of the ship owner for a new ship.

F.1.50 evaluate weights of outfitting and accommodation : This activity defines all separate weights belonging to the outfitting and accommodation.

F.1.51 feedback : The outputs from activities which then feed back and modify previous activities in the lifecycle on the current or subsequent ships.

F.1.52 final compartment design:

F.1.53 finalise and approve general arrangements : The activity that details the

general arrangement after having created a draft layout. The ship's systems are described by a compartment and access drawing showing the location, the access, and the size of the different compartments.

F.1.54 finalise and approve hull form : The activity in which the hull form is finalised from the preliminary design. The result is a final and approved hull form design.

F.1.55 finalise and approve hydrodynamics and powering * : This includes all relevant hydrodynamic calculations such as resistance, propulsion, seakeeping and manoeuvrability.

F.1.56 finalise capacities calculations : The activity which produces the final volumes and centres results for the final calculation of stability and trim.

F.1.57 finalise compartment definition : The activity which gives the definition of the ship's compartments.

F.1.58 finalise general arrangements : The activity in which the general arrangements are finalised from the preliminary design.

F.1.59 finalise production planning * : This produces outputs relating to the final construction sequence, the material supply and the management of time and people.

F.1.60 finalise stability and trim calculation : This activity produces a finalised trim and stability parameter.

F.1.61 finalise weight estimation : Produces the final weights and centres of gravity for the calculation of the final stability and trim.

F.1.62 floodable curves : Used in the activities which define compartments to establish the main bulkhead positions.

F.1.63 freeboard : The freeboard is the distance from the waterline to the upper surface of the freeboard deck at side.

F.1.64 fuel consumption : A fuel consumption calculation is used to estimate the needs of capacities for fuel.

F.1.65 general arrangements : The space arrangement plan from the preliminary design stage.

F.1.66 historical data from previous designs : Data held by the shipyard or model basin on previous ship designs and used to estimate the hydrodynamics, powering requirements and sea-keeping.

F.1.67 hull form sections : The design of the hull moulded form at planar sections taken along the longitudinal axis of the ship.

F.1.68 hull moulded form : The definition of the shape of the hull of the ship, resulting from the addition of the aft-body, mid-body and fore-body definitions, which does not take into account the thickness of the material from which the hull is made.

F.1.69 hull steel weights : These outputs are the results of several calculation and design activities which result in an estimated weight of the steel structure making up the hull.

F.1.70 hydrodynamics & powering results * : The results of calculations and model basin tests. They contain resistance, propulsion, propeller performance, brake power, service speed, sea keeping and manoeuvrability data.

F.1.71 hydrostatics *: Hydrostatic properties are used in checking of ship's stability.

F.1.72 knowledge and experience : The previous experience and knowledge of companies involved throughout the ship lifecycle.

F.1.73 laws, rules and regulations : National laws, statutory regulations and classification society rules that are used to control the design, manufacture, operation, maintenance and scrapping of the ship.

F.1.74 list of required certificates * : The result of placing an order, this is the list

supplied by the owner for certificate requirements.

F.1.75 machinery design * : The design drawings and electronic models of the ship mechanical systems. An output from the final design process.

F.1.76 machinery weights : These outputs are the results of several calculation and design activities which result in an estimated weight for all machinery.

F.1.77 manufacturing restrictions : A constraint on the ship construction and design processes governed by available technology and shipyard facilities.

F.1.78 material list * : The list of raw materials needed to manufacture the ship. A result of the final design process.

F.1.79 material allocation/ordering : The data describing the necessary material supply for production.

F.1.80 modifications from machinery : Modifications to the hydrodynamics and powering due to feedback from the preliminary machinery design.

F.1.81 modifications to hull form : Modifications to the hull shape due to feedback from hydrodynamics and powering results and the final design process.

F.1.82 offer : The result of the preliminary design process. It will contain the shipyard's data for producing the requested ship.

F.1.83 offer guidelines : The offer guidelines include the data necessary to make an unconditional offer to the ship owner

F.1.84 operate and maintain a ship * : The activity that describes the running and maintenance of the ship during its service lifetime.

F.1.85 operational information : Accumulated information during the operation phase of the ship used for maintenance and in the final scrapping stage.

F.1.86 outfitting weights : These outputs are the result of several calculation and design activities which result in an estimated weight for all outfitting systems and furnishings.

F.1.87 owner : The organisation which requests, orders and takes delivery of the ship.

F.1.88 owner request, requirements : The requirements document that is submitted to the shipyard by the owner upon the invitation to tender.

F.1.89 payload : This output calculates the payload as a function of the available capacities.

F.1.90 perform DAP (Design Approval Preview) : This is the top level activity for the approval preview of ship design. This activity is a feasibility study conducted by a Classification Society, in which the design is checked very roughly to detect critical areas for thorough investigation and conformity checking both as a design comment and to draw attention to specific areas during design approval. The content of this activity may vary with contract specifications and type of ship.

F.1.91 perform ship lifecycle : All of the lifecycle activities associated with a ship.

F.1.92 place order * : The owner places an order for a ship from the bids that have been submitted. From this a contract is awarded.

F.1.93 planned maintenance system : Data created during the final design process and used during the operation and maintenance of the ship.

F.1.94 position of collision BHD : The position of collision bulkhead for passenger ships is usually constrained by the SOLAS convention for passenger ships and other rule constraints for other types of vessels.

F.1.95 pre layout : The very initial layout of the ship which is produced during the bid evaluation stage and is the basis for the preliminary design.

F.1.96 preliminary design : The preliminary design is that which is completed in the phases leading up to the submission of the tender.

F.1.97 preliminary hull form : The definition of the hull form, as a result of the preliminary design process. Used in the offer documents and for preliminary compartment design, hydrodynamics and powering calculations.

F.1.98 preliminary machinery design * : The definition of the ship mechanical systems. Used early to estimate the noise, speed and vibration and to estimate the machinery weights.

F.1.99 preliminary machinery, structure and outfitting design : Feedback consisting of the preliminary designs for machinery, structure and outfitting and furnishing. This allows the creation of preliminary general arrangements.

F.1.100 preliminary outfitting design : The definition of the ship's outfitting and accommodation, resulting from the preliminary design process.

F.1.101 preliminary structure design : The definition of the preliminary ship structure during the preliminary design process.

F.1.102 prepare bid : This activity includes all activities of the yard regarding preparation and submission of the offer to the ship owner for the ship to be built.

F.1.103 present offer * : The activity concerned with presentation of the offer to build the ship to the prospective ship owner.

F.1.104 produce and inspect a ship : This activity includes high-level activities such as produce, monitor and inspect ship production. Inspect, means the controlling of all activities throughout the whole production life cycle of a ship.

F.1.105 product component information * : The technical data about the components that will be incorporated into the ship. These are taken into consideration when the preliminary designs are being made.

F.1.106 propeller design * : The design of the propeller or propulsor as a result of the hydrodynamics and powering calculations. The design controls some of the machinery design activity.

F.1.107 refined design : The final compartment definitions.

F.1.108 request a ship * : The first activities of a ship owner when intending to order a ship. Having definite ideas regarding appearance and functionality of the ship, the owner expresses these ideas in an inquiry to the shipyard.

F.1.109 request for production changes : Changes that are requested to the ship design as a result of production experience or difficulties with the realisation of the ship design.

F.1.110 resistance and shaft power : The result of the activity to estimate hydrodynamics and powering. Resistance and shaft power is a constraint on the creation of the preliminary hull form.

F.1.111 resources : The shipyard, classification society, and outside consultants.

F.1.112 resources allocation : A result of production planning.

F.1.113 schedule : The schedule is formed as a part of the final design process. It governs the timing of the production phases.

F.1.114 scrapping plan * : The document used to schedule the time and resources required to dismantle the ship.

F.1.115 ship product model data : The product data of the accumulated throughout its lifecycle. Because scrapping is part of the lifecycle the ship is not an output, only the documented information and knowledge about the ship survives.

F.1.116 ship weight modifications : Modifications to ship weight due to the preliminary structure design. This is fed back to modify the preliminary hull form and revise the preliminary general arrangements.

F.1.117 shipyard : An organisation that designs, builds, maintains, and repairs ships.

F.1.118 specify ship : All activities associated with the production of a detailed specification of the

ship prior to a contract being placed.

F.1.119 stability parameter : Parameters including several results of stability calculations.

F.1.120 structural design * : The design of the hull structure including hull, bulkheads, decks and stiffeners.

F.1.121 technical requirements : The owner's specifications that must be realised by the completed ship.

F.1.122 technical documentation : In case of maintenance the technical documentation of a system means part of the product description required to perform preventative maintenance, repair and failure analysis of that system. Technical information is an output which includes more detail information about material parts needed for producing the ship/system.

F.1.123 transportation need : A constraint which determines the specification for the ship construction.

F.1.124 tonnage : Tonnage is a method of volume calculation applied to ships.

F.1.125 trim : The expected floating position of the ship resulting from calculation of the weights and their distribution throughout the ship.

F.1.126 volumes and centres : Volumes and centres of holds, bunkers, tanks and compartments.

F.1.127 weights and centres of gravity : Weights and centres of gravity necessary for further calculations.

F.1.128 weight distribution * : The details of the weight distribution taking into account steel weight, machinery weights, outfitting weights and cargo.

F.1.129 workload * : The total effort required to build the chosen ship design as estimated by the shipyard and assisting consultants.

Annex G
(Infomative)
Application Reference Model

G.1 ARM UoF EXPRESS Schemas

Annex L
(Informative)
Technical Discussion
6.2 Arrangement (Internal Subdivision)
The hull form of a ship is internally subdivided early in the design lifecycle by the introduction of many additional surfaces. These surfaces are associated with the molded hullform elements such as bulkheads and decks. Structural entities such as plate parts and stiffeners will be defined on these surfaces as the design progresses. A region of the ship --whether it be interior to the hull such as a tank or enclosing one if its exposed decks such as a helicopter landing platform-- is designated a space. Two types of spaces are addressed by this AP --compartments and zones. Compartments which represent physical, bounded spaces and zones, which represent regions surrounded by some abstract boundary.

The most common type of spatial partioning is the sudivision of a ship into compartments. A compartment is very similar to the idea of a room in a building. The compartment is bounded by the surfaces representing structural decks and bulkheads and also by non-structural (or non load bearing) surfaces that form "joiner bulkheads". Compartments may be classified according to the function they perform with regard to the operation of the ship. The types of spaces supported by this AP are cargo/stowage (both liquid and dry cargo), void, habitable, and machinery/equipment. Collections of attributes have been defined for the various compartments depending on its designated use. Compartments serve a vital function in configuration managing engineering part occurrences throughout the lifecycle of the ship.

In some cases, the same surfaces that subdivide a ship into compartments may also be used to subdivide the ship into zones. In other cases, additional hullform geometry elements and/or geometric surfaces may be required to define zone boundaries. On naval ships, multiple zone subdivisions --such as, pressure (Collective Protection System), subsafe, damage control, and arrangement zones-- will be defined and each subdivides the hull into an independent set of spaces. Sometimes, two zones may have the same boundary, however, each zone is still independently represented.

In addition to identifying the various spaces on the ship, it is important to represent the connectivity between these spaces. This model supports several types of relationships between spaces, specifically adjacency, functional, positional, and enclosing. Adjacency relationships are established via a connectivity network based on the connection/joint model presented earlier in this document. Characteristics such as accessibility, access time, and common surface area between adjacent spaces are provided such that analyses to determine transit times between areas of the ship and HVAC load calculations can be supported. Functional relationships can be used to record the fact that one space's design parameters are dependent on some functional characteristic of another spaces --such as a pair of port and starboard ballast tanks used for anti-roll stabilization. Positional relationships capture design intent expressing the fact that certain spaces must maintain geometric characteristics similar to another spaces' --such as two spaces that should maintain the same transverse width dimension. Finally, enclosing relationships allow the product model to record the fact that one space may be completely surrounded by another space --such as a free-standing Lube Oil Settling Tank in the Machinery Space.

From a functional standpoint, the model has been developed to associate properties with the various compartments appropriate to their function. These properties include volumetric capacities, length measures, and cross-sectional areas. The ability to specify constraints on these properties is provided for where appropriate so as to assist engineers in the early stages of design. For example, it is possible to specify a minimum length for a compartment, as well as a maximum length for the compartment. Likewise, it is possible to record an estimated compartment volume, as well as a calculated and a measured. Longitudinal and transverse grids can be defined for an arrangement zone that can be used to restrict the free placement of bulkheads such that they align with the grid points.

6.3 Compartments
A ship is divided horizontally by decks, platforms, flats, levels, and the bottom shell. These divisions apply to the entire ship, both in the main hull and in the superstructure (or deckhouse). Deck gratings, false decks, or similar flats are not considered as division boundaries. Between horizontal division boundaries, the ship is divided vertically by tight or nontight bulkheads. Except for spaces designated as voids, cofferdams, or tanks, only tight boundaries are considered.

Every volume enclosed by horizontal and vertical boundaries (except for minor utility areas such as peacoat

lockers, linen lockers, cleaning gear lockers, and other similar areas) is considered a compartment. Some compartments, by this definition, may or may not have access closures. Compartments are assigned a compartment name and a compartment number. Compartments that extend vertically through more than one horizontal division boundary, such as machinery spaces and deep tanks, are considered to be located on the lowest horizontal boundary.
Figure F-140 illustrates the subdivision of one deck of a typical Naval vessel. The following table presents a listing of common compartment attributes --such as compartment name, compartment number, and applicable design zone-- for a similar vessel

COMPARTMENT NUMBER	COMPARTMENT	DESIGN ZONE
1 - 46-0 -M	5"/54 CALIBER LOADER DRUM & FAN ROOM	1350
3 - 52-1 -M	5"/54 CALIBER POWDER MAGAZINE NO.1	1330
3 - 42-01-M	5"/54 CALIBER POWDER PROJECTILE MAGAZINE	1330
1 -364-1 -T	ACCESS TRUNK	2450
1 -140-2 -Q	ADMINISTRATION OFFICE	4210
1 -196-1 -T	ACCESS TRUNK	2450
2 -310-1 -L	AFT BATTLE DRESSING STATION	3440

6.4 Zones

6.4.1 Design Zones

One common type of internal subdivision is the "design" zone. Whereas a compartment is a subdivision involving the functional aspects of a completed, or in-service, ship, a design zone is associated with the manufacturing of a ship by the design agent and/or shipbuilder. Design zones are used to break up the ship into blocks for facilitating design and construction.
Design zones, like compartments, are bounded by surfaces representing decks, bulkheads, the hull, and so on. They may also be bounded by other surfaces. A common use of the design zone is to configuration manage aspects of the ship design process within its bounds. For this reason, the subdivision model model has been developed to allow product structuring by zone. Structural parts, structural assemblies, and engineering parts can all be associated with a particular zone of the ship. Figure F-141 illustrates the design zones of the DDG-51, the lead ship of the Arleigh Burke class destroyer.

6.4.2 Fire Zones

The design of a naval ship is likely to provide fire containment capablities. A Damage Control Console provides remote control fire containment at a central site. The ship design process entails subdividing the vessel into a number of fire zones. A fire zone boundary is a physical boundary designed to retard the passage of flame and smoke from one area of the ship to the next. All fire
zone boundaries are watertight or fumetight bulkheads. Fire zone boundaries in the hull are constructed of steel. Bulkheads in the superstructure, if aluminum, are covered with non-combustible thermal insulation. Each fire zone boundary on the Damage Control Deck is provided with spring loaded, joiner type, fire doors, each held open by an electromagnetic catch. An adjacent quick acting watertight door is also provided. Each fire zone has fire, smoke, and heat sensors which activate a central display on the hazard detection panel of the Damage Control Console and enable the ship's crew to safely and effectively monitor and control onboard fires. Figure F-142 depicts the Fire Zone Boundaries and Fire Doors of a (Aegis) Ticonderoga class curiser.

6.4.3 Collective Protection System (CPS) Zones

Another type of zone common on Naval ships is a pressure zone. These pressure zones are used to define regions of the ship that have been designed to maintain a pressure slightly higher than that of the outside atmosphere. These zones, commonly referred to as collective protection system (CPS) zones, are necessary to combat biological and nuclear warfare. The air pumped into these zones is specially filtered to remove harmful contaminants. As with fire zones discussed above, the boundaries of these zones are fitted with special types of automatic closures to secure the zones in an emergency.

6.4.4 Arrangement Zones

The last type of zone to be discussed here is the arrangement zone. This zone is used early in the design to

control and manage the arrangement of compartments on the ship. An individual or workgroup may be assigned a collection of compartments that are to be arranged within a given domain (i.e. the arrangement zone). Working within the bounds of this zone, the designers can define the compartment boundaries according to the requirements for the spaces --such as number of crew, amount of cargo, etc. To facilitate standardization, longitudinal and transverse grids may be established that constrain the placement of bulkheads.